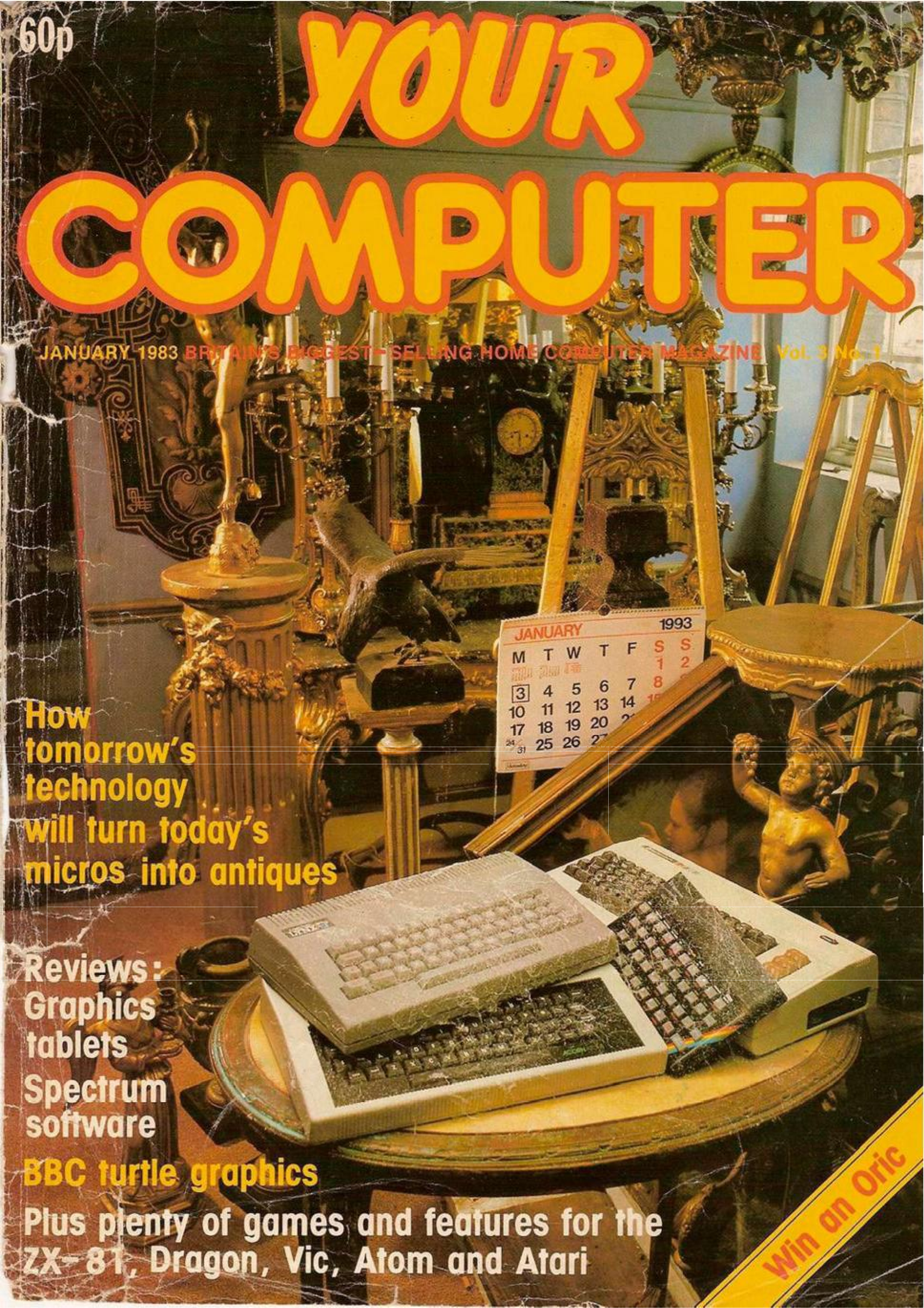
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YOUR COMPUTER

JANUARY 1983 BRITAIN'S BIGGEST-SELLING HOME COMPUTER MAGAZINE Vol. 3 No. 1



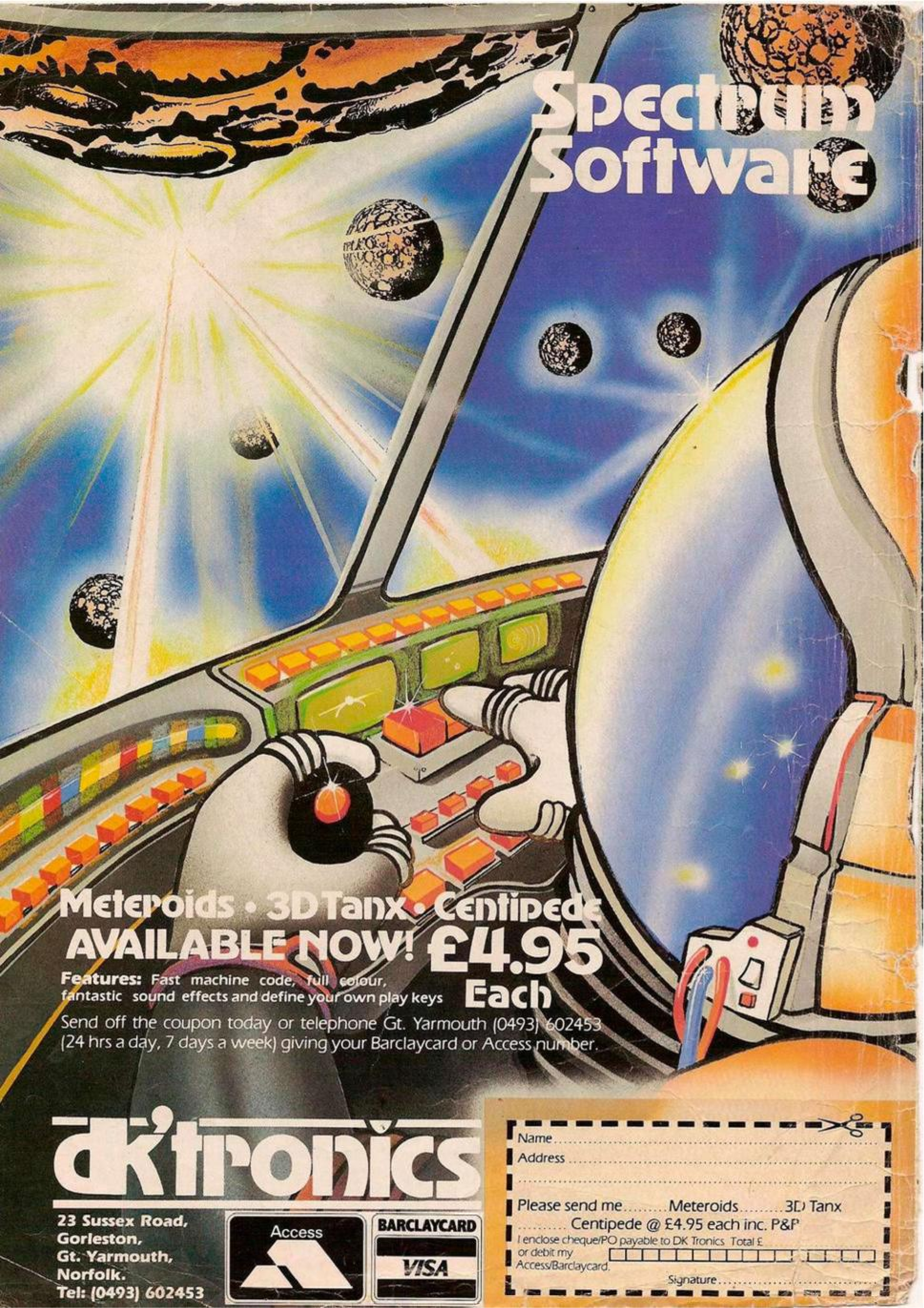
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EDITORIAL

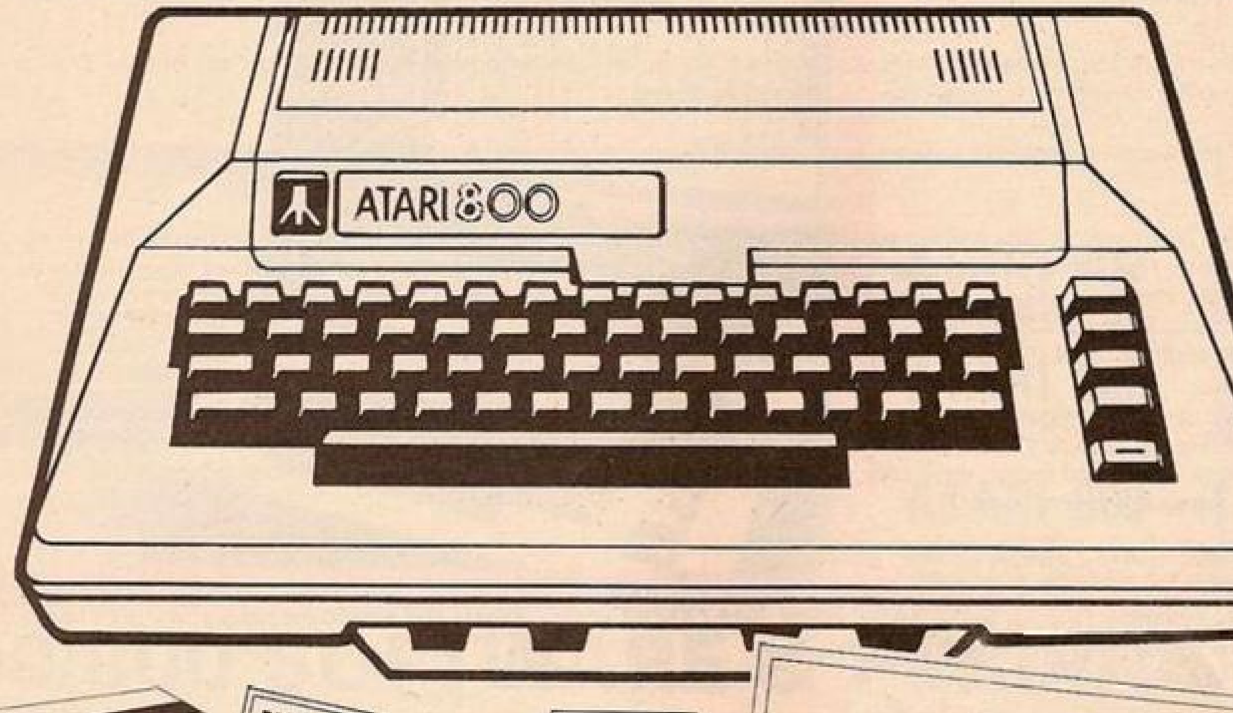
SO THAT WAS IT 82. If the most impressive failing of the Government's year-long £2 million crusade to promote new technology was that very few people were aware of its existence, at least we can rest easy in the knowledge that "information technology" — the woolly jargon coverall apparently invented for the occasion — never quite made it into everyday vocabulary either. The organisers claim that IT 82 was a success; after all, a recent MORI survey showed that 62 percent of the population had heard of IT. A similar proportion of the country may have heard of quantum mechanics but few will have any idea of its effects on current or future life.

That a few people did notice something going on can probably be put down to Information Technology year's incongruously low-technology methods for seeking publicity. Those whose memories have not been too badly shot away by machine code may recall, for example, the wind-powered yacht launched in the summer and symbolically named *Information Technology,* or perhaps with less of an effort remember last autumn's inordinately long postage stamps which made use of their extra length to fend off electronic mail and put over a brief hi-tech slogan.

In a few years time, when antique dealers are bidding fiercely at Sotheby's for a pristine ZX-80, certain professional historians will undoubtedly try to make a living out of computing as their specialist subject. One of these academics may well try to make out the case that IT 82 was responsible for the boom that took place in home computing the same year. It is the sort of mistake that historians should be forgiven for making — especially when one looks dispassionately at the astounding progress that has been made in the last year. A year ago home computers were silent, black and white, low resolution, twice as expensive, had half as much memory and — as a result of all that — were three times rarer than today.

Now home computers are something worth having and at a price that is within the reach of the ordinary person. In 1982 computing moved out of the hobbyists' domain and into the consumer market. That transformation has far more to do with the demystification of computing and the new technology than a whole decade of Information Technology years. The process of educating the public about the benefits and dangers of the new technology must continue indefinitely. If it does not, those historians of the future may remember IT 82 rather as they remember the Great Exhibition of 1851 — a magnificent display of all that was latest in science and technology followed by years of neglect and a rapid decline. ■

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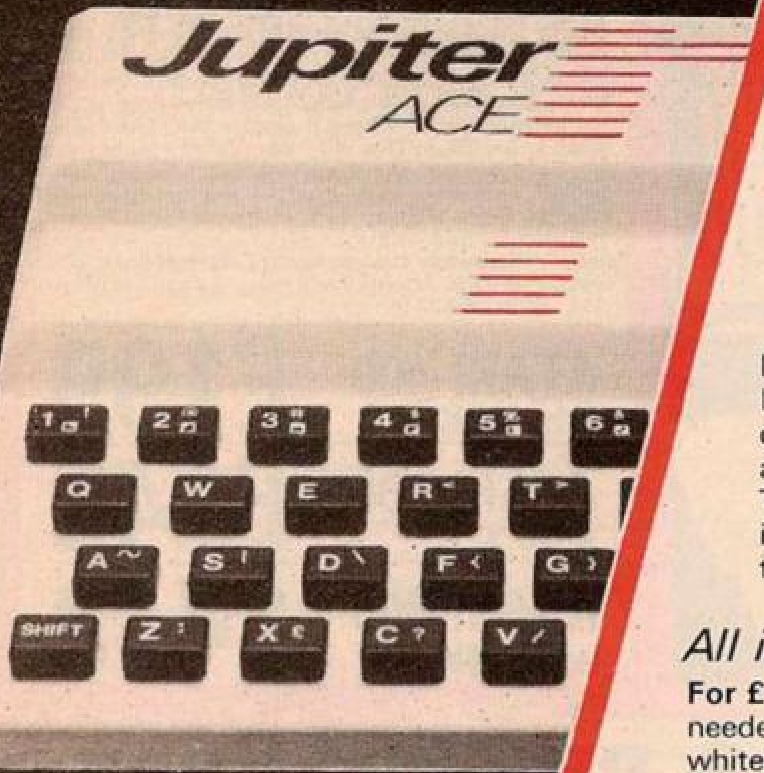
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YC0183 — Your Computer — January 1983

Jupiter ACE



The Jupiter Ace personal computer runs in FORTH, an easily understood language, typically four times as compact and ten times as fast as BASIC. Before the Ace all personal computers used BASIC and FORTH was only available to a privileged few.

The Jupiter Ace also features a full-size moving-key keyboard, high-resolution graphics, sound, floating point arithmetic, a fast and reliable cassette interface and 3K of RAM.

If you own a personal computer you will be aware of the limitations of BASIC. You know how slowly your programs run and how quickly your computer's memory gets filled. The Jupiter Ace is your answer.

If you already know FORTH, the Jupiter Ace closely follows the FORTH 79 standard with extensions for floating point, sound and cassette. It has a unique and remarkable editor that allows you to list and alter words that have been previously compiled into the dictionary. This avoids the need to store screens of source, allowing the dictionary itself to be saved on cassette. Comprehensive error checking removes the worry of accidentally crashing your programs.

All inclusive price

For £89.95 you receive your Jupiter Ace, a mains adaptor, all the leads needed to connect to most cassette recorders and T.V.s (colour or black and white), a software catalogue and a manual.
The manual is a complete introduction to the world of personal computing and a course in FORTH programming on the Ace.
Even if you are a complete newcomer to computers, the manual will guide you step by step from first principles to confident programming.
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The Jupiter Ace is backed by a full 12 month warranty.

"The Ace is an excellent way of using FORTH"
Popular Computing Weekly

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Speed Comparison Chart showing times in seconds to perform one thousand operations.

Type of Operation	Jupiter Ace	BBC Micro	Vic 20	Spectrum	ZX81
Empty loop	0.12	0.67	1.3	4.2	17.7
Print a number	7.5	13.5	26	19	430
Print a character	0.62	1.3	3.1	7.5	24
Add two numbers	0.45	1.4	5.5	7.5	28
Multiply two numbers	0.9	1.6	6.5	7.5	32

Because of the difficulty in devising exactly equivalent programs, these measurements should only be taken as a guide.

only £89.95

Designed by Jupiter Cantab

Computer Designers Steven Vickers and Richard Altwasser played a major role in creating the ZX Spectrum and then formed Jupiter Cantab to develop advanced ideas in personal computing. The Ace is the result, another all-British computer to lead the world.

Technical Information

Hardware
Z80A running at 3.25 MHz.
8K bytes ROM
3K bytes RAM

Keyboard
40 Moving-key keyboard with auto repeat on every key and Caps Lock.

Screen
Memory mapped 32 column x 24 line flicker-free display with upper and lower case ascii character set.

Graphics
Chunky graphics (64 x 46 pixels) may be plotted, unplotted or over-plotted (XOR operation). Also, the entire character set (128 characters and their video inverses) may be redefined allowing intricate shapes to be drawn with a resolution equivalent to 256 x 192 pixels.

Control Structures
IF–ELSE–THEN, DO–LOOP DO–+LOOP, BEGIN–WHILE–REPEAT, BEGIN–UNTIL, all may be mixed and nested to any depth.

Cassette
Programs and data in the compact dictionary format may be saved, verified, loaded and merged. Blocks of memory can be saved, verified, loaded and relocated. All tape files are named. Running at 1500 baud, the Ace will connect to most portable tape recorders.

Expansion Port
Contains D.C. power rails and full Z80 Address, data and control signals. May be used to connect extra memory and other peripherals. IN and OUT words allow port-based peripherals to be addressed.

Data Structures
Integer, Floating point and String data may be held as constants, variables or arrays with multiple dimensions and mixed data types. There are no restrictions on names.

Sound
Internal loudspeaker may be programmed to operate over the entire audio spectrum.

Programming in FORTH

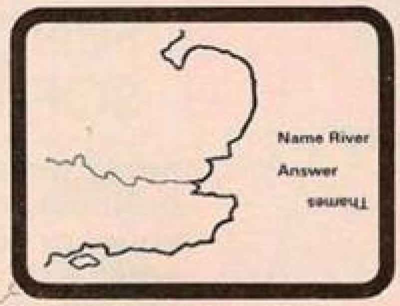
Programming in FORTH

FORTH programs are constructed without line-numbers, as words which are defined in terms of other words that already exist. Consider the following definition of the word **STARS**. Comments are in parenthesis and have no action.

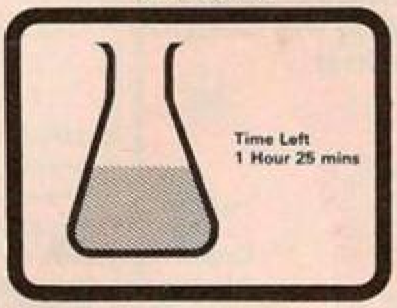
```
: STARS          (: starts word definition)
    ." ***"      (print 3 asterisks)
  200 100 BEEP   (play a note for
                    100 mSecs)
;
```

The semi colon at the end finishes the word definition. Now, whenever you say **STARS** the computer will print out 3 asterisks and sound a short tone. (Notice how the word **BEEP** comes after the numbers it uses, 200 and 100. This characteristic occurs throughout FORTH so that you write, for instance, 28 76 + instead of 28 + 76.)

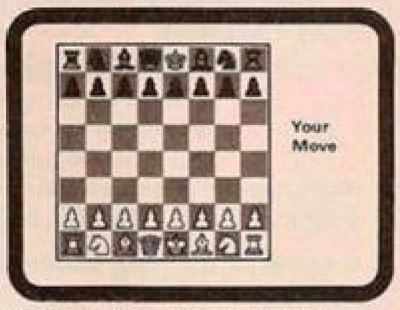
The Jupiter Ace already has 140 FORTH words defined in ROM.



In Schools Teachers already know how quickly children take to computing, and the Jupiter Ace is an ideal introduction. FORTH is an easy and important language to learn and by making learning fun, the Ace can help to teach science, music and many other subjects.



In Laboratories For monitoring and controlling experiments, the Jupiter Ace has many advantages. The language is perfect, even the Jodrell Bank Radio Telescope is controlled in FORTH. The Ace expansion port enables it to be interfaced to almost anything, and the built in quartz timer allows experiments to run all weekend.



At Home The Jupiter Ace is powerful enough to play games as complex as Chess and with sound and high resolution graphics, action games written in FORTH will stretch your reaction speeds to their limits.



In the Office Stock control, Accounts and Financial forecasts are all possible on the Jupiter Ace. With a printer and extra memory attached you can do word processing as well.

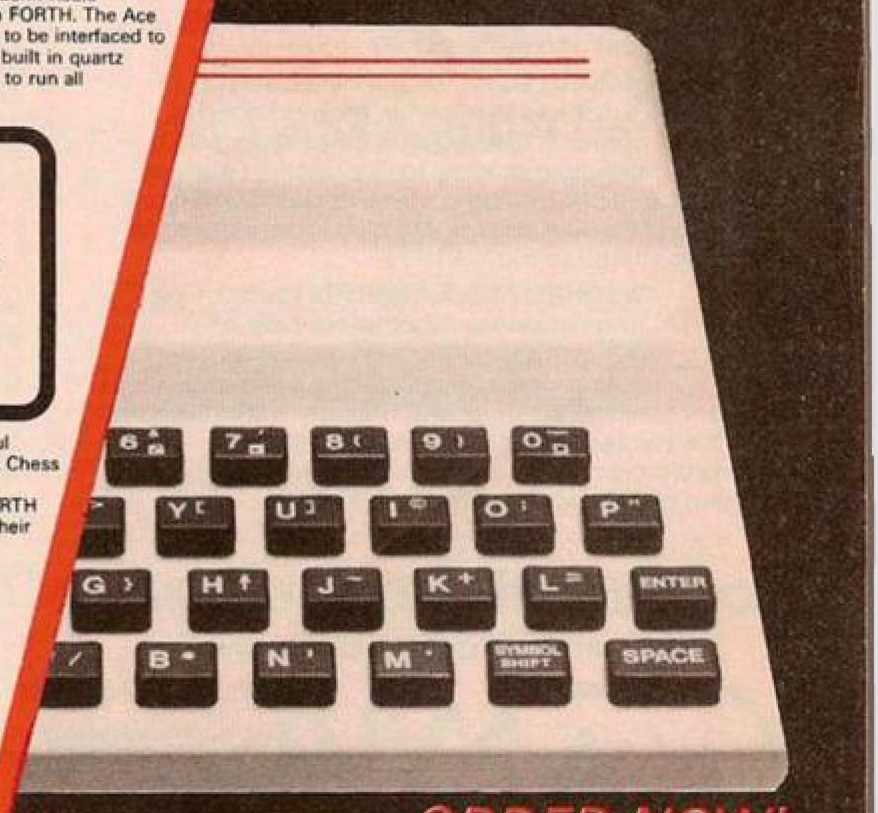
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The amazing new British computer with a full-travel standard keyboard, a 16-bit microprocessor, 32K RAM fitted (expandable to 64K and later to 256K!!), 9 colours, hi-res graphics and Microsoft extended colour BASIC (the very best BASIC to learn with). It can be used with virtually any ordinary cassette recorder, it has a printer interface (Centronics-type), joysticks are available and it's incredible value for money. **(AF57M) Only £199.50**

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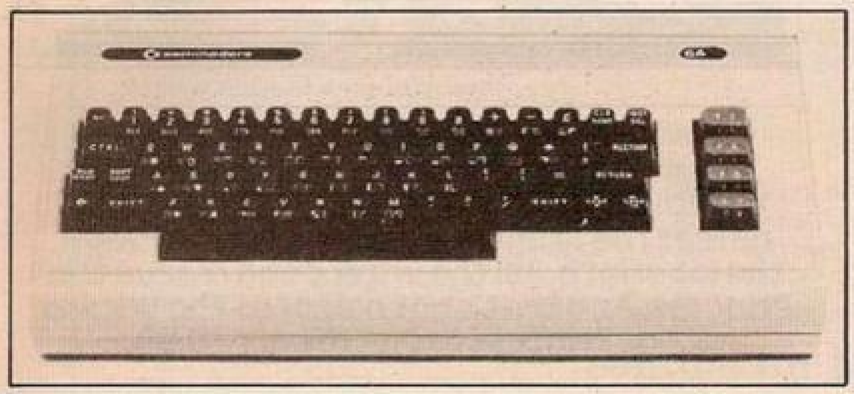
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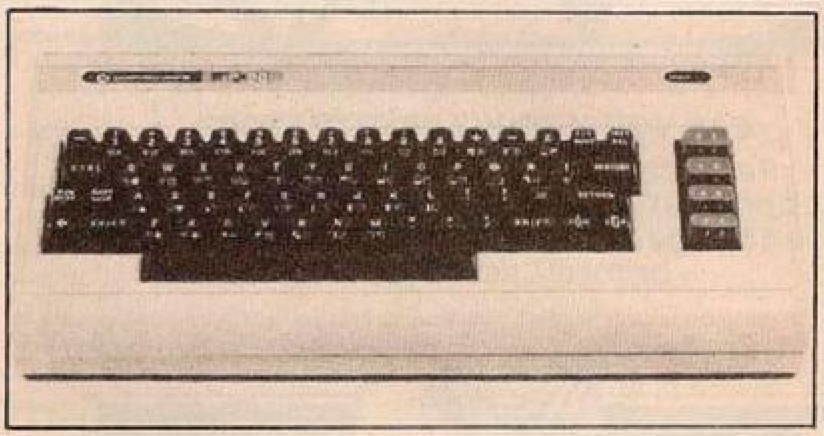


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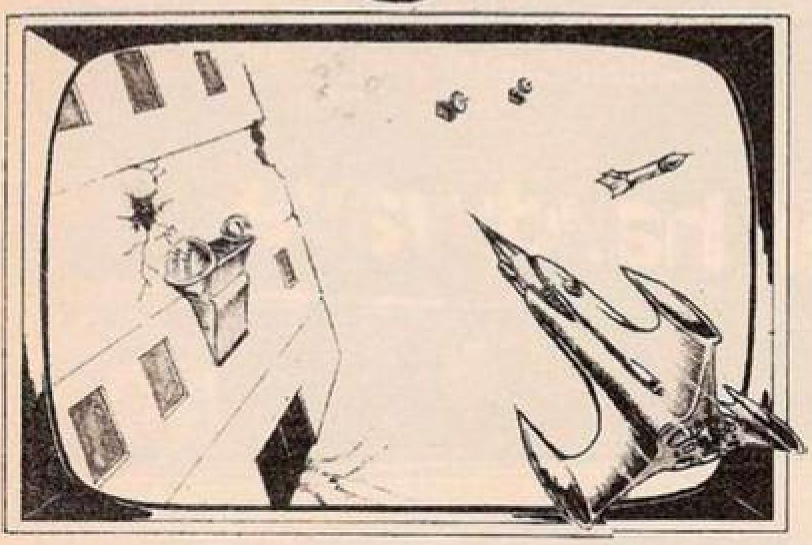
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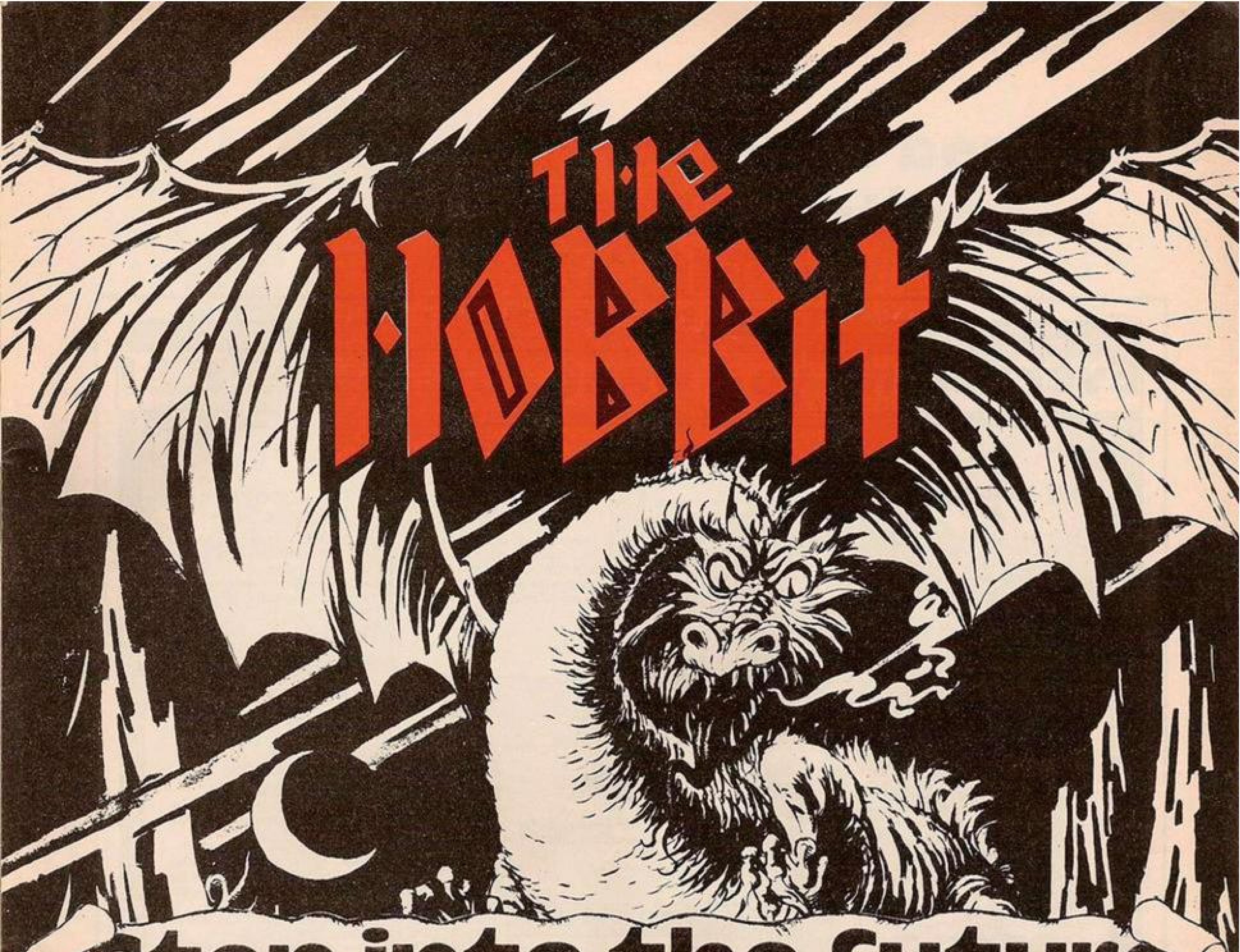
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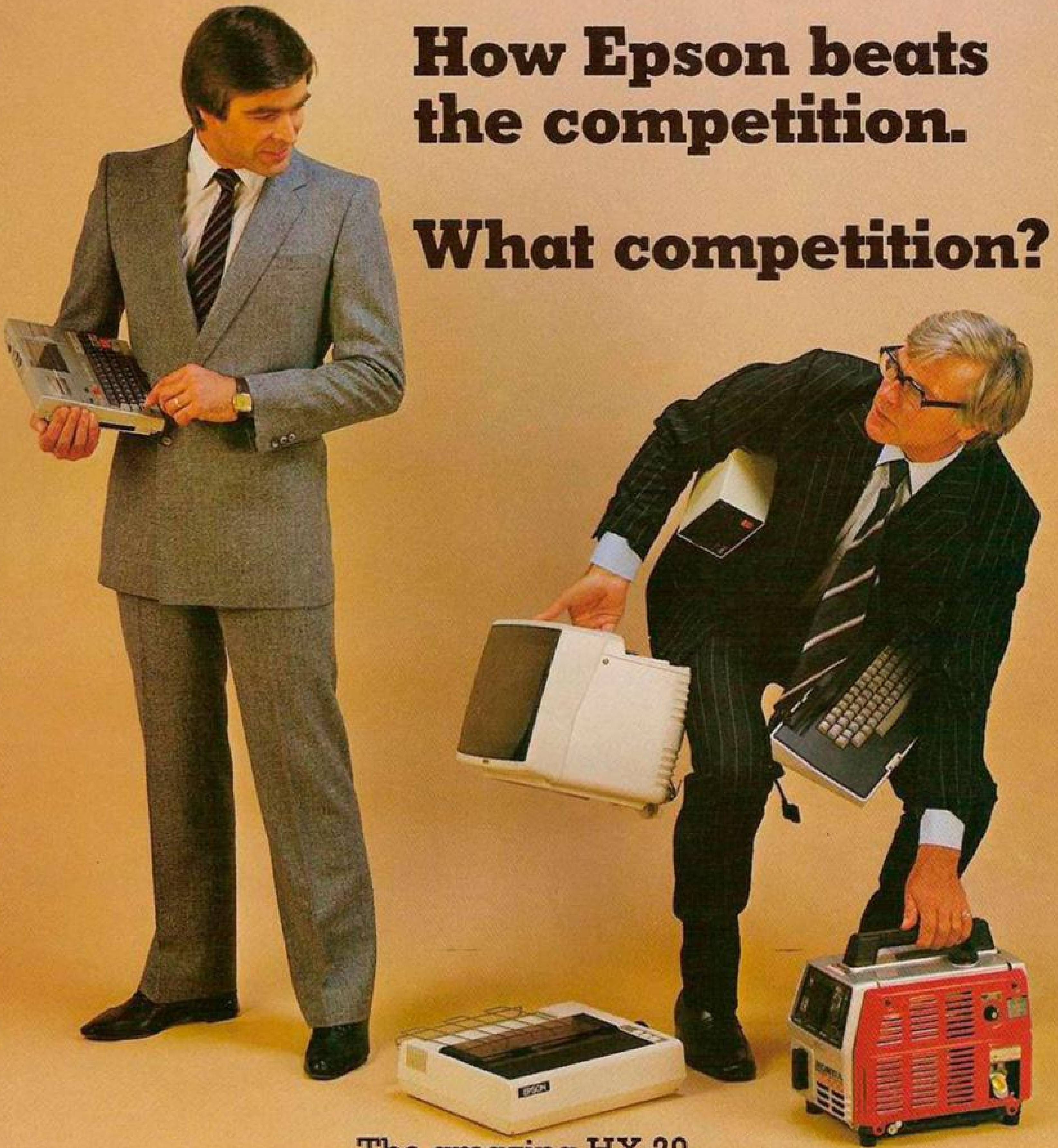
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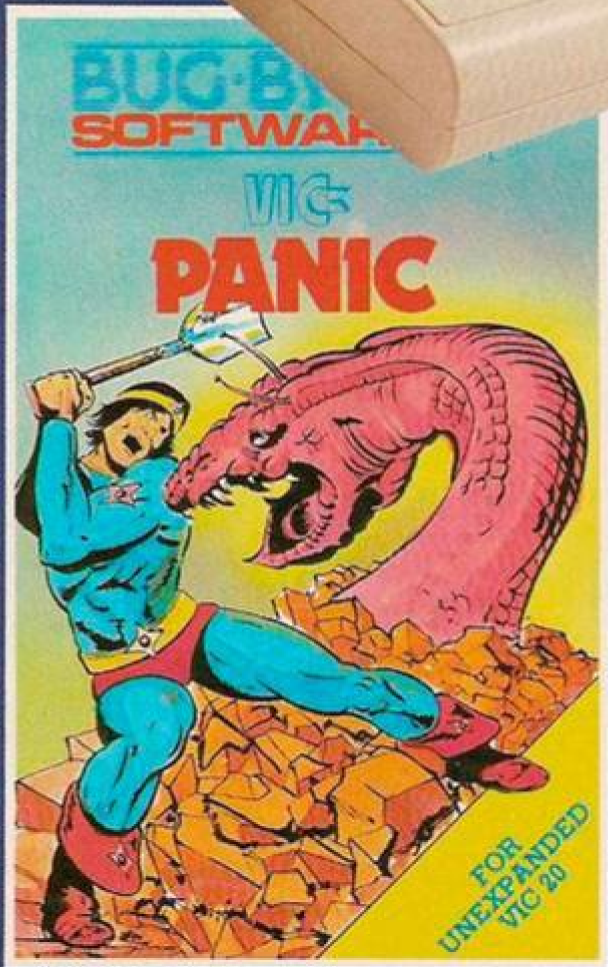
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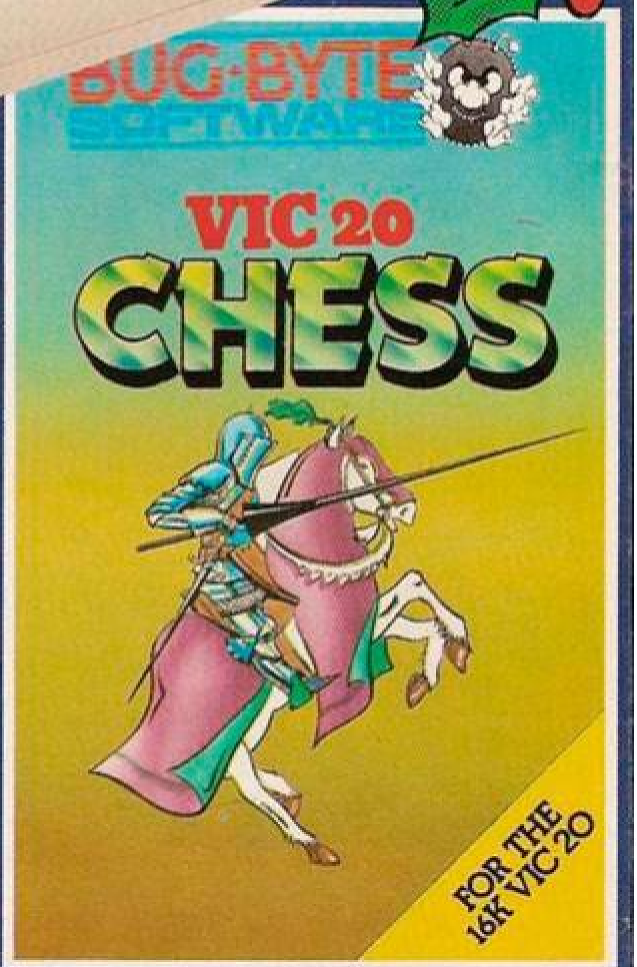


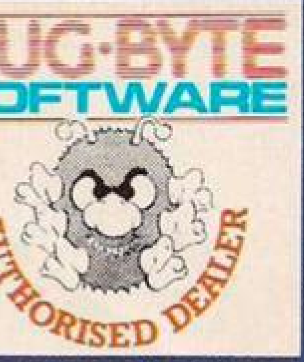
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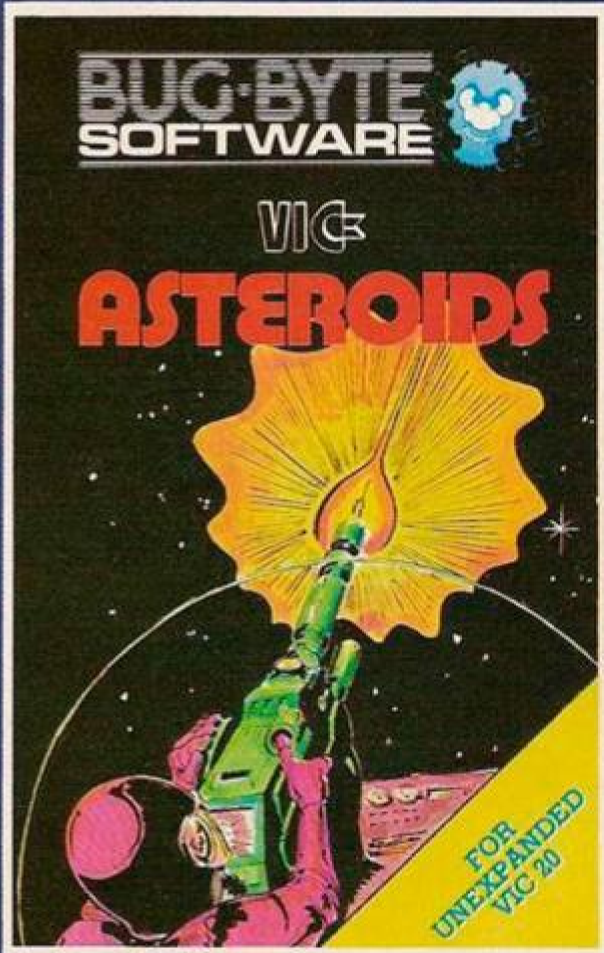


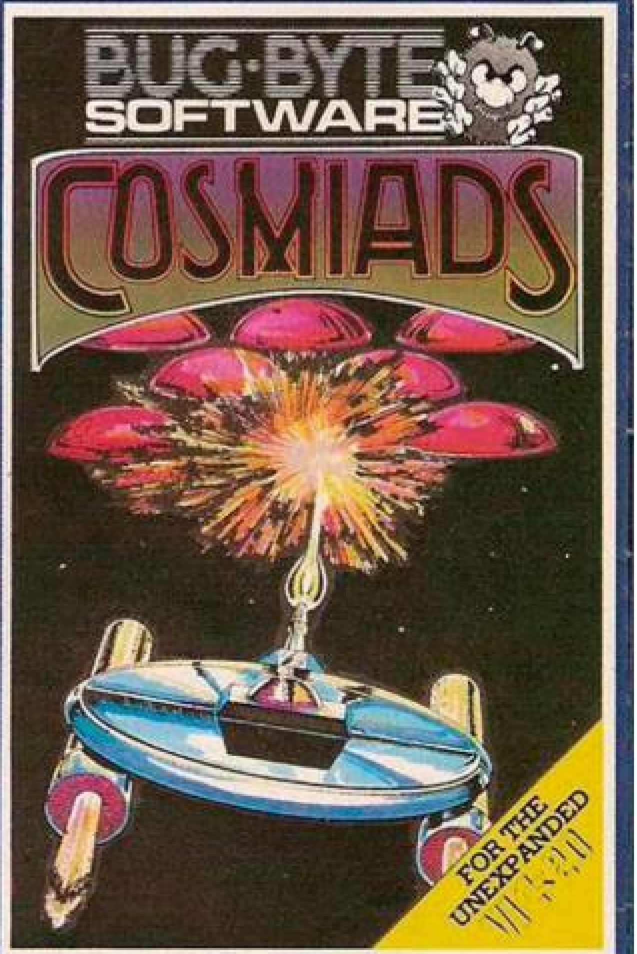




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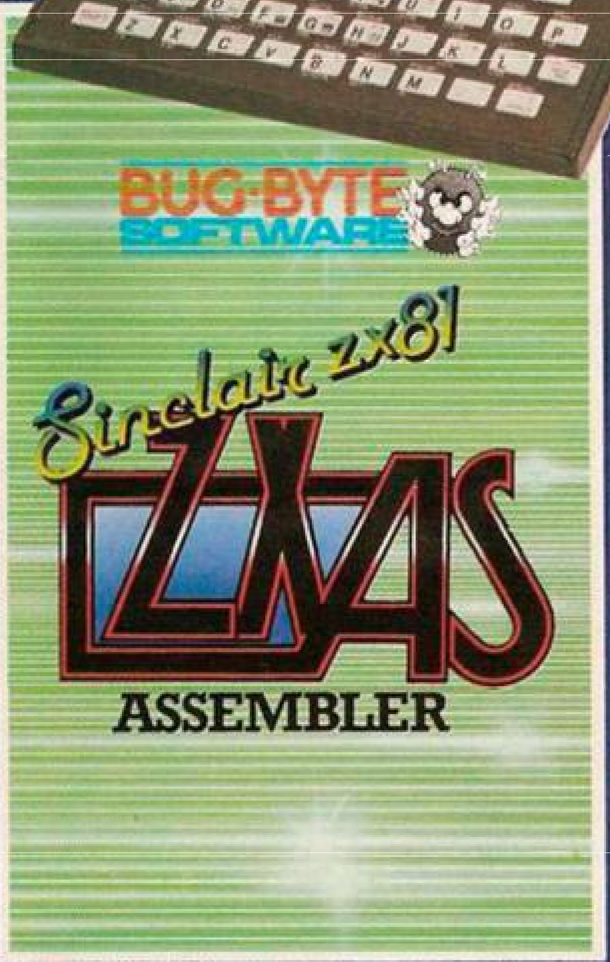
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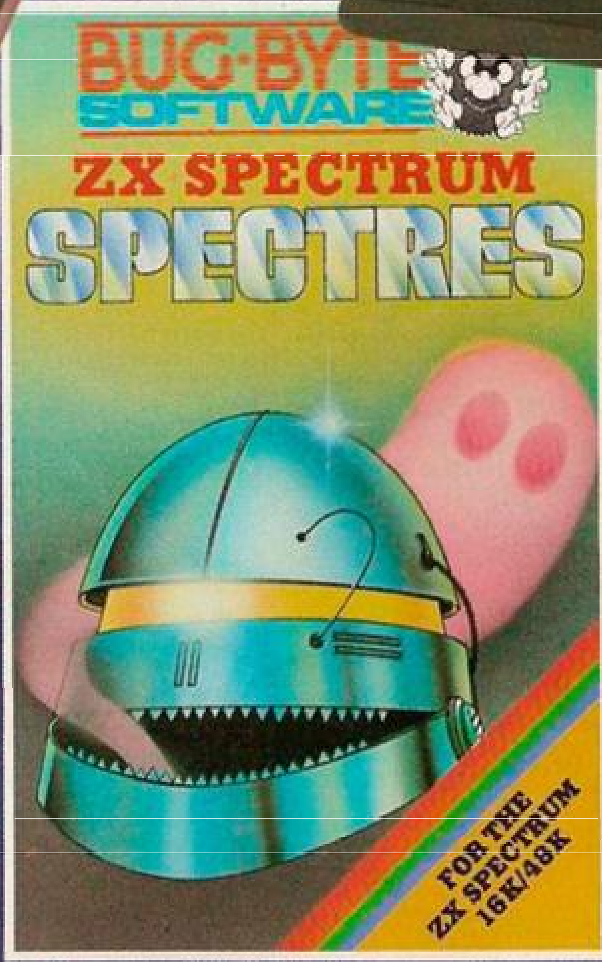
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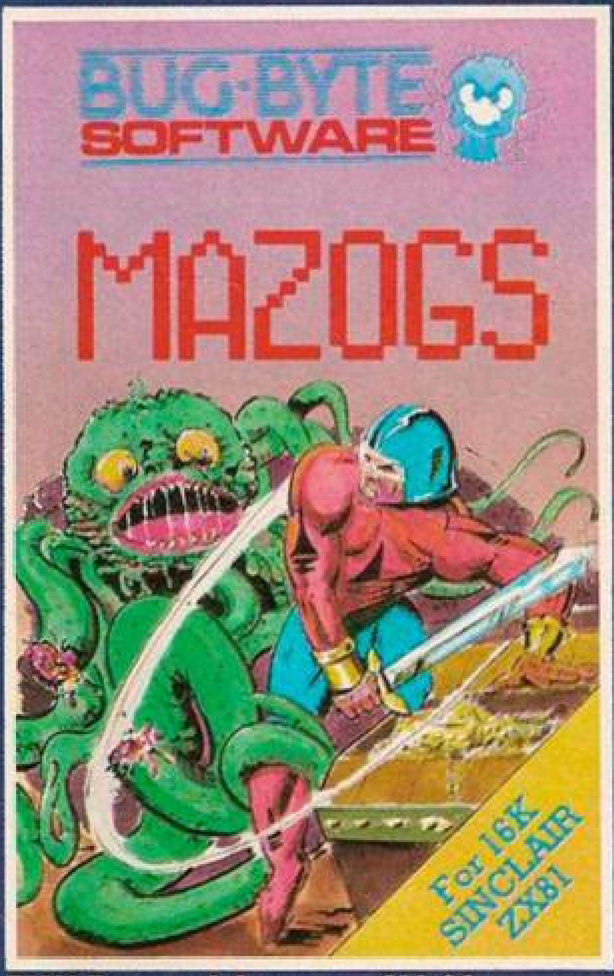


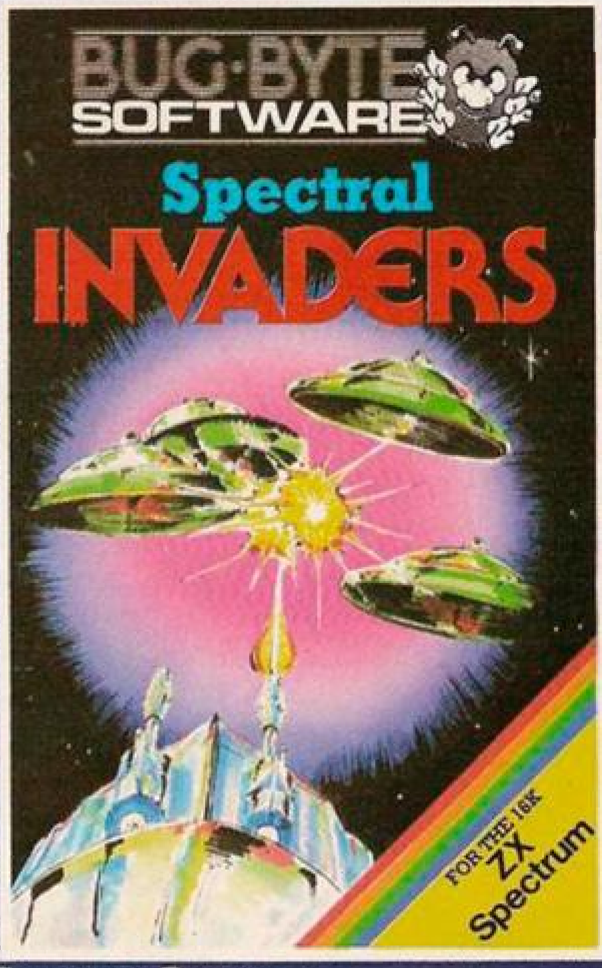


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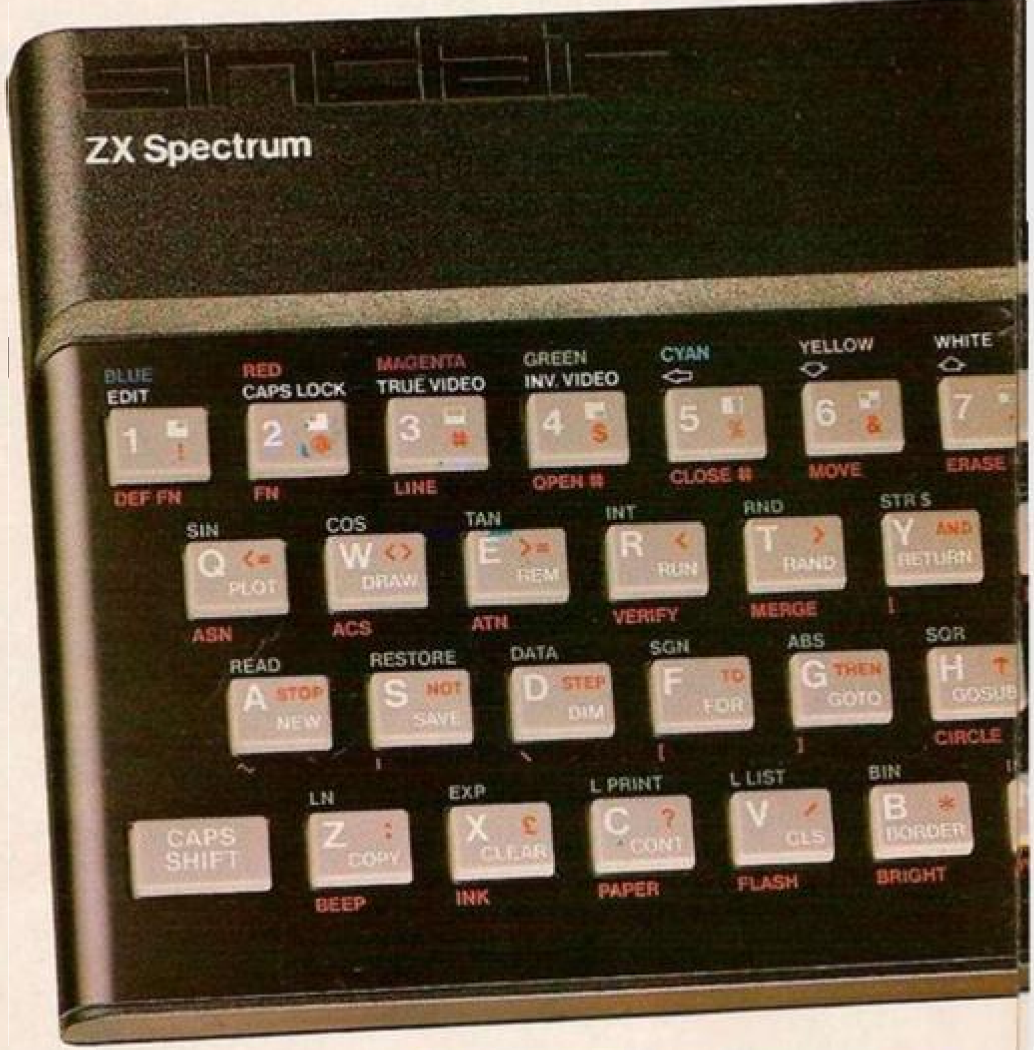
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Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

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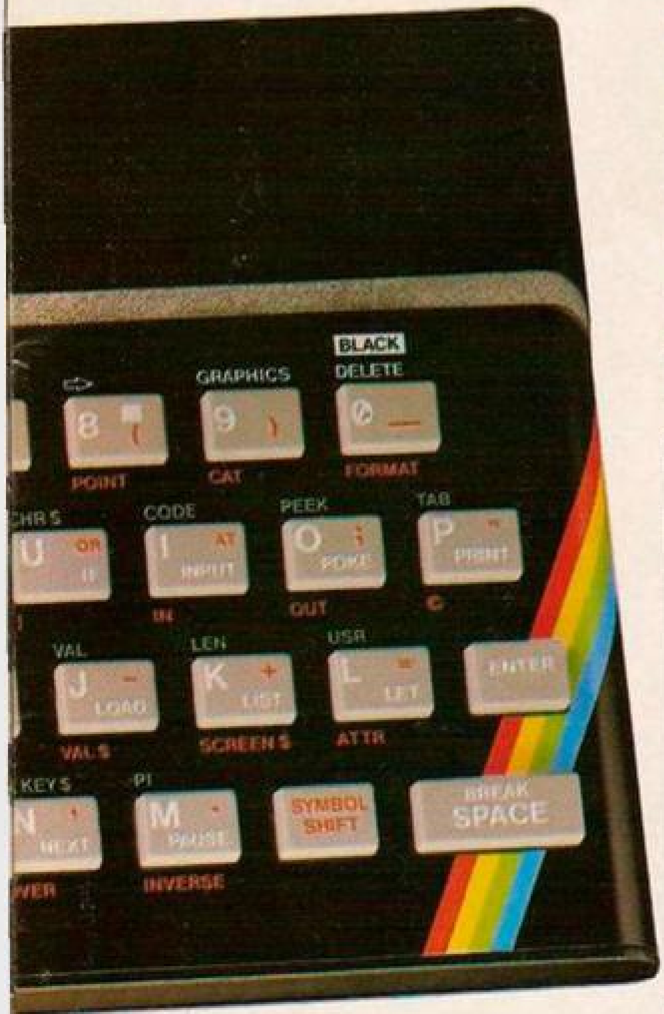
There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
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- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
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- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

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The first 21 software cassettes are now available directly from Sinclair. Produced by ICL and Psion, subjects include games, education, and business/household management. Galactic Invasion...Flight Simulation...Chess...History...Inventions...VU-CALC...VU-3D...47 programs in all. There's something for everyone, and they all make full use of the Spectrum's colour, sound and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

RS232/network interface board

This interface, available later this year, will enable you to connect your ZX Spectrum to a whole host of printers, terminals and other computers.

The potential is enormous. And the astonishingly low price of only £20 is possible only because the operating systems are already designed into the ROM.

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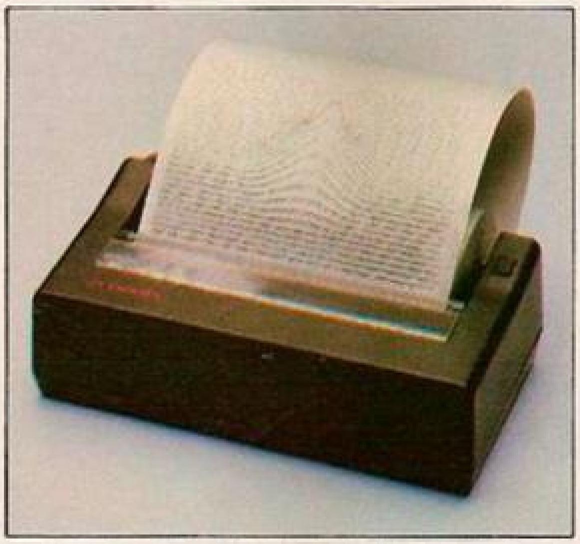
Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS. Tel: Camberley (0276) 685311.

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – *including lower-case* characters and high-resolution graphics.

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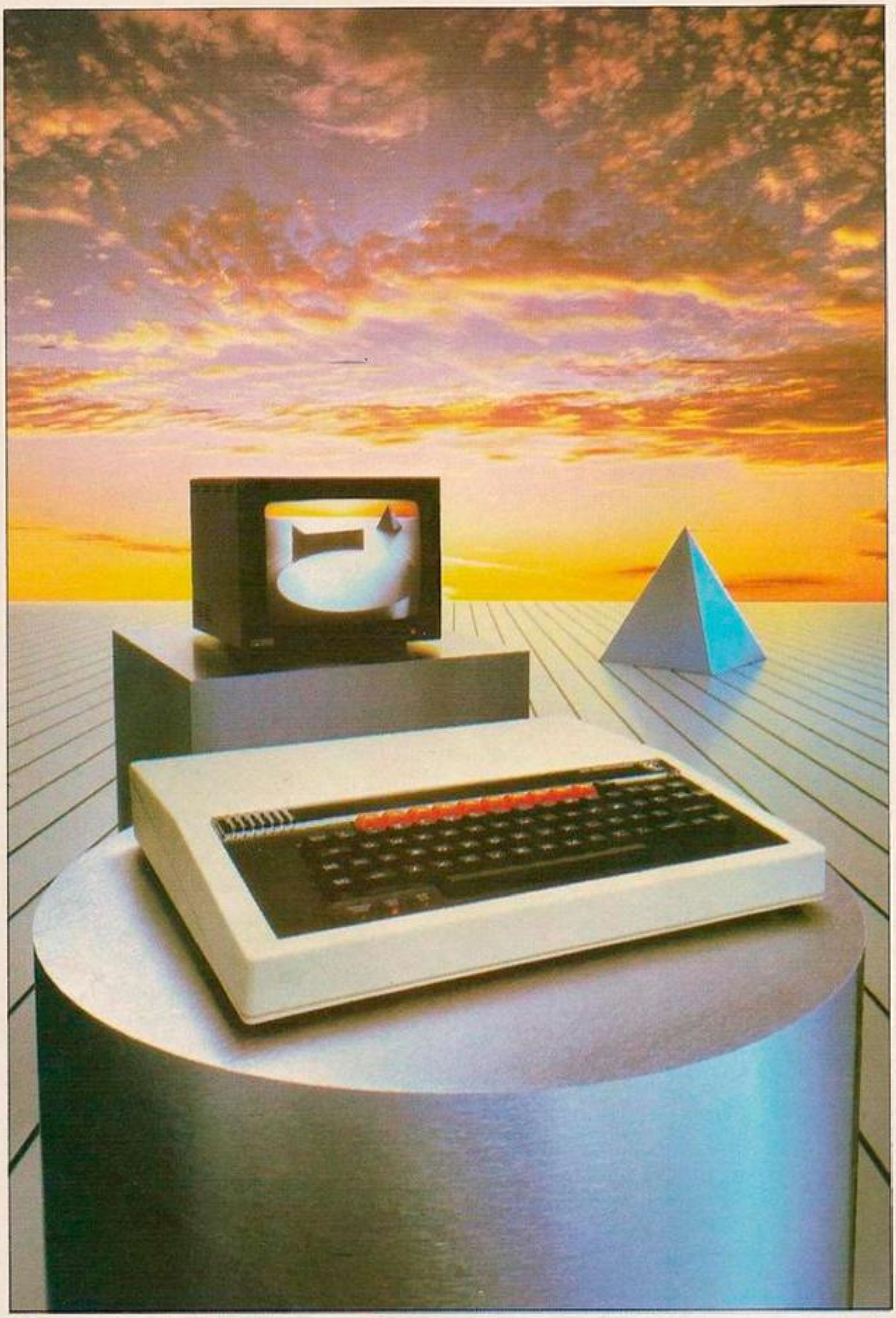
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You can connect directly* to cassette recorder, domestic television, video monitor, disc drives, printers (dot matrix and daisy wheel) and paddles. Interfaces include RS423, inter-operable with RS232C equipment, and Centronics. There is an 8-bit user port and 1MHz buffered extension bus for a direct link to Prestel and Teletext adaptors and many other expansion units. The Econet system allows numerous machines to share the use of expensive disc drives and printers.

BASIC is used, but plug-in ROM options will allow instant access to other high level languages (including Pascal, FORTH and LISP) and to word processing software.

A feature of the BBC Microcomputer which has attracted widespread interest is the Tube, a design registered by Acorn Computers. The Tube is unique to the BBC Microcomputer and greatly enhances the expandability of the system by providing, via a high speed data channel for the addition of a second processor. A 3MHz 6502 with 64K of RAM will double processing speed; a Z80 extension will make it fully CP/M** compatible.

The BBC Microcomputer is also at the heart of a massive computer education programme. The government has recommended it for use in both primary and secondary schools. The BBC Computer Literacy Project includes two series of television programmes on the use and applications of computers.

There are two versions of the computer. Model A, at £299, offers 16K of RAM and Model B at £399 has 32K of RAM.

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*Model A has a limited range of interfaces but can be upgraded to meet Model B specification.
**CP/M is a registered trade mark of Digital Research.

The BBC Microcomputer is designed, produced and distributed in the UK by Acorn Computers Limited.

ZX GAMES

Several errors crept into my article ZX-81 Games Writing in the November issue of *Your Computer*. These are as follows:

1. Program 2 — an open brackets symbol is missing in the Line 1 Listing. This should be placed between Not and Clear.

2. Program 5 — the graphics character before the second RND should be CHR$63h not a space.

3. Hexloader — line 60 should read:

```
60 PRINT AT 11,7;X;"spc.";A$(1 TO 2)
```

Text should read: "To save typing both Rem statements type in line 1 Rem 255 0s".

4. Frogger program — to Run the display Line 10 should be changed to:

```
10 RAND USR 16701
```

not USR 16702, as stated.

Stuart Nicholls,
Keynsham,
Bristol.

GREMLINS

Here are some amendments to Rod Hopkin's Spectrum Flight Simulator — December issue — which other readers may find helpful. Most of them arise because the screen construction plotting commands do not correspond entirely with those of the main program.

Line 103: change address 23054 to 23086 and similarly change lines 8745 and 9521.

```
8710 DRAW 84,0 instead of 86,0
9657 DRAW 84,0 instead of 86,0
```

In line 9651 A$="" should read

```
A$="(12 graphic 5s)"
```

Add the following lines:

```
9658 PLOT 30,7: DRAW 28,0
9501 POKE 23200,0
```

There are also some errors in figure 3:

```
Line 24 FOR N=1 to 14
```

should be:

```
FOR N=1 to 16.
```

To tidy up the screen display, the following line may be added to figure 3:

```
1010 OVER 1
1020 PLOT 31, 17
1030 FOR Q=143 to 153: PLOT Q,
     23:NEXT Q
1040 PLOT 143, 25: PLOT 152, 25:
     PLOT 153,25
1050 PLOT 152,33: PLOT 153,33
1060 OVER O
1070 PRINT PAPER 4; AT 18, 18; "O".
1080 PRINT PAPER 4; INK 7;
     AT 19, 18;"O"
1090 FOR Q=143 to 152: PLOT INK 7;
     Q, 31: NEXT Q
2000 OVER O
```

S Rendall,
Abergavenny,
Gwent.

MACHINE CODE

I would like to make an amendment to figure 7, page 68 of the October issue. Lines 16540 to 16547 are missing — these can be seen in program 5c immediately above the erroneous program 7.

The code from address 16540 to 16546 has been omitted. It should have been the same as in program 5 above it, that is:

```
16540  LD HL (NN) 42 12 64
       LD DE  NN  17  3  0
       ADD HL  DE  25
```

Perhaps I can add two further points to the series which may help readers list and edit the program.

We use 118 for the end-of-line marker and this, of course, will stop the printer and Rem from going beyond the point at which the number first occurs. You can get round this problem by using the following technique:

Required	Solution
LD A N 62 118	LD A N 62 117
or	INC A 60
LD C N 14 118	LD C N 14 117
	INC C 12

Only one point to watch. INC affects the flag variable. Also if you use the number 126 in your machine-code program, the five digits which follow it will not be shown on the screen.

Sinclair uses this code to indicate that a number follows, the number being stored in the next five addresses. If you now enter the code into the editor, parts will disappear. Solution — if you use the code 126 in your program, you must not edit the line. Try it, and see what happens.

Kathleen Peel,
Crowborough,
East Sussex.

HAUSER VIEW

I would like to point out a few factual errors in your interview with Clive Sinclair since it refers to an earlier interview with me. Sinclair's claim in paragraph 2, page 39 of your November issue that his display takes 8K to do exactly the same as Acorn's display does in 20K is incorrect. As some people know, our display has the following eight graphic modes:

Mode		Memory
	Model B only	
0	640×256 2-colour graphics and 80×32 text	(20K)
1	320×256 4-colour graphics and 40×32 text	(20K)
2	160×256 16-colour graphics and 20×32 text	(20K)
3	80×25 2-colour text	(16K)
	Models A and B	
4	320×256 2-colour graphics and 40×32 text	(10K)
5	160×256 4-colour graphics and 20×32 text	(10K)
6	40×25 2-colour text	(8K)
7	40×25 Teletext display	(1K)

The Sinclair display has only one mode, and it can only display 40 characters on the screen, giving neither the 80-character option necessary for word processing, nor the 20-character option needed for demonstration to a number of people gathered around the display.

The main shortcoming of the Spectrum display, however, is its lack of high-resolution colour graphics: since colour can only be assigned to character fields, as opposed to individual pixels as in the Acorn computer range, the colour resolution is only 32 × 44 = 1,408 colour fields, as opposed to 160 × 256 = 40,960 in the Acorn case.

The lack of a palette, which allows instant colour changes on the screen, is another difference between Sinclair and Acorn. A palette is vital for animated graphics.

I also found Sinclair's old advertisement in your November issue, which still compares the Spectrum board with the BBC board, claiming that the Spectrum "provides more power". In a recent test the BBC Computer was shown to be almost four times faster than the Spectrum.

Although I think the Spectrum is a reasonable computer, Sinclair's claims that it is "more powerful" than the BBC Computer and that it can do with 8K of memory what we need 20K for, cannot be substantiated and are simply false.

Hermann Hauser,
Managing Director,
Acorn Computers.

PROGRAM NAME

I have been very pleased with Mr Alan Went's Program Name for the ZX-81, November, page 110. However, some of your readers may have been having problems with it. It will work perfectly with the improved ROM, but with the origninal ROM — the one with the arithmetic bug — it will only work in Fast mode. In Slow mode it will print rubbish and sometimes crash. This is because it incorporates a call to the Fast routine and this was moved when the ROM was improved.

If you have the original ROM alter the beginning of line 10 to

```
LET A$ = "CD200F
```

or use the program as it is, but then execute the instruction Poke 16515,32. In both cases the beginning of line 1 will then appear as

```
REM LN 4?
```

It is also worth mentioning that the routine does not alter the print position and so can be embedded easily in a fancy presentation. For example:

```
10 PRINT "PROGRAM TITLE: """";
20 RAND USR 16514
30 PRINT """"
```

will produce:

```
PROGRAM TITLE: "NAME"
```

Finally, the program is not relocatable, as it incorporates calls to itself, but I will leave that up to the readers' intelligence.

G J W Cunliffe,
Horsham,
West Sussex.

BBC FACTS

In reply to G A Bobker's letter, November, there are some facts that I feel should be corrected. I own a BBC Micro and, although I do agree that it is expensive, I do not agree with his comments on BBC Basic.

Overall, the BBC Micro mixes the best of both worlds. G A Bobker also said it was preferable to buy cheaper computers, hence more. He suggested a ZX-81 as an example of this idea, but I can tell you from personal experience that Sinclair Basic is even more non-standard than BBC Basic is supposed to be. An example of this is using X$(...) instead of the standard Mid$, Left$ and Right$, which the BBC uses, for string slicing.

P M Exell,
Great Missenden,
Buckinghamshire.

ZX LOAD

Many thousands of ZX-81 users are still plagued by the machine's inability to Load and Save regularly. The problem seems to be that the TV is emitting a very powerful mains hum, which interferes with both tape recorder and computer. Try this: first of all, type Save "Filename", then insert the Mic lead from the ZX-81 into the appropriate socket in the recorder. Next, insert a small earphone into the earphone socket on the recorder. Now, turn off the TV and allow it to cool down. Press Play/Record and Newline. You will know then the Saving is complete, from the sounds coming from the earphone.

This done, the program should Load back with little difficulty.

Robert Lazarus,
Harrow,
Middlesex.

ONE-LINER

Andrew Glaister's strange Spectrum One-Liner, page 25 November issue, creates its spectacular graphics by a software bug which can, however, produce several useful results. The fault stems from the angle portion of:

```
PLOT x,y:DRAW a,b,n*PI
```

if large odd values of n are used. But when n=63 an octagon is drawn, inscribed on an imaginary circle whose diameter is defined by the line joining (x,y) and (x+a, y+b).

If the value of n is altered to 189 an eight-pointed star is drawn. 24, 56 and 72-pointed stars can be drawn, using appropriate values of n. The following program shows the effect clearly by drawing a 3D view of an octagonal conic:

```
10 LET n=63
20 FOR a=120 TO 30 STEP -10
30 PLOT 55,27 : DRAW a,a,n*PI
40 NEXT a
```

The list below shows the values of n that produce well-defined shapes. I have not yet been able to produce any sharp images of odd-sided polygons or stars.

	n				
Octagon	63	441	567		. . .
8 side star	189	315	693	819	. .
24 side star	105	147	273	357	. .
56 side star	225	279	297		. . .
72 side star	301	343	.		. . .

Alan Marley,
Ruislip,
Middlesex. ■

Blank Hitachis greet Spectrum

SOME SPECTRUM OWNERS have found that they are unable to get a colour display on their colour televisions. The Spectrum's colour signal appears to be incompatible with certain makes of colour television built overseas. The problem has been reported with TVs from Hitachi, National Panasonic, Toshiba, Grundig and Telefunken, although it does not occur on every model in these manufacturers' ranges.

Sinclair says that although the Spectrum was tested on a variety of different makes, it could not have been expected to have covered all television manufacturers. However Sinclair is now considering publishing a list of recommended makes.

Sinclair gives fiction prize

WHEN THE SINCLAIR fiction prize was first announced many people wanted to nominate Clive Sinclair himself for promising 28 days delivery on the Spectrum.

Now, with machines available over the counter at large branches of W H Smith the real winner can be revealed. *Death is part of the Process* won Hilda Bernstein £5,000 for a piece of fiction based on the grim reality of her battle to win human rights for women and blacks in South Africa — the country she and her husband fled in 1964 after he was arrested with Nelson Mandela.

Mandela is still in the prisons of South Africa's apartheid regime.

Customised to public speaking

CHATTERBOX IS THE NAME of a new phoneme speech synthesiser for the ZX-81 and Spectrum microcomputers. Unlike speech packs which provide a number of already formed words, phoneme speech synthesisers supply the component sounds of a word — vowels, diphthongs and consonants. You need to be a skilful programmer to take advantage of phonemes but they allow you an unlimited vocabulary.

William Stuart Systems, the manufacturer, says that an average of six bytes will store the phoneme codes for a spoken word, so 10K bytes would store over 1,600 words.

The system includes an amplifier and a loudspeaker and has sockets for a speech recognition unit and a music synthesiser, also supplied by the manufacturer. It costs £56.53 from William Stuart Systems Ltd, Dower House, Herongate, Brentwood, Essex CM13 3SD. Tel: 0277 810244.

Casio's £80 light-weight PB-100 joins personal-computer club



CASIO INSISTS that the PB-100 is a personal computer and not just a glorified calculator. A cheaper and slightly less powerful version of the FX-700P, the PB-100 runs Basic and can take up to 544 program steps. When a plug-in RAM pack is added it offers a maximum of 1,568 steps which works out to be around 2K.

Like programmable calculators it allows up to 10 programs to be stored at a time and retained in memory when the power is shut off. Programs can also be held on tape if a cassette interface is bought as an extra.

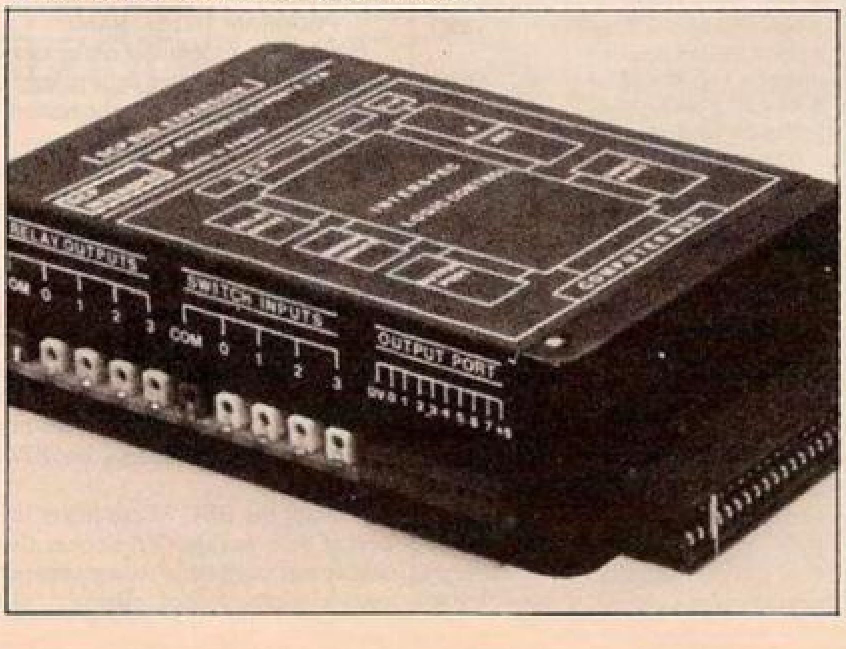
The PB-100 is remarkably light and compact, weighing just over 4 ounces measuring 9.8 by 16.5 by 0.7 cm. and costing less than £80. It has a 12 position LCD display and a 54 key alphanumeric keyboard, with single-key entries for Basic commands.

DCP Products who supply a range of accessories for the ZX-81 has developed this multiple interface pack for the Spectrum, the DCP Interspec. It includes an eight channel analogue to digital converter for joysticks or temperature sensors, eight-bit input and output ports, four relay outputs for high-current control and four buffered switch inputs.

There is also a 15-way connector at the rear of the pack which can control up to four more accessories as it stands or, with a few additional components, up to 255 other devices.

DCP's other new product is a Spectrum version of their speech pack for the ZX-81. This offers the letters of the alphabet, the numbers zero to a million, and a few other common words and sounds. By plugging in up to three Word Pack ROMs vocabulary can be extended to several hundred words.

The Interspec and Speech Pack, which cost £39.95 and £49.95 are available from DCP Products, 2 Station Close, Longwood, Norwich, NR13 4AX, and from many ZX dealers.



When in ROM, Oric EPROM



AT LAST ORICS are now streaming off the production line to start meeting the 250,000 orders already placed for the £99 colour micro.

The first few thousand do not have the final ROM chip but an EPROM instead. John Tullis, managing director of Oric Products International is confident that "users will not be able to tell the difference".

Oric decided to blow the EPROMs as soon as the design of the ROM had been finalised rather than have to wait another month for the production ROMs to be delivered.

At first Oric plans to concentrate production on the 16K and £175 48K models but a 32K machine at £140 is also planned.



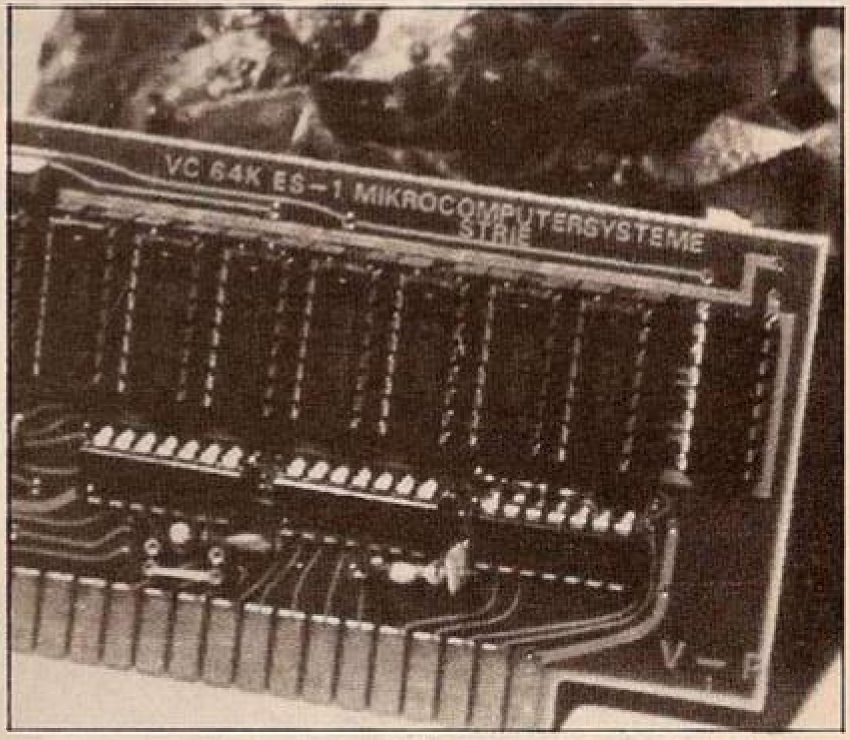
High Street dealers to hold all the Aces

The Jupiter Ace has overcome initial production problems and is now being delivered in numbers. Aces are now beginning to appear in high street stores. Jupiter Cantab is producing 3,000 units a month. The Cambridge based company hopes to phase out mail-order deliveries and handing over distribution to several large chains, including Lasky's and Greens.

Software for the Ace is also on the way. Steven Vickers, who designed the fast Forth micro with Richard Altwasser, and three other software writers are developing a range of games and educational programs to be released shortly.

Meanwhile Remsoft has already released three tapes for the Ace. Programs include a disassembler, games, and a simple database with tape storage. They are available direct from Remsoft, 18 George Street, Brighton BN2 1RH. Telephone 0273 602354.

Double-Dutch RAM expansion for Vic-20



NORMALLY THE VIC-20 has a maximum memory capacity of around 28K and this requires an expansion board to take an 8K and 16K RAM pack together. Now a Dutch firm has produced a RAM pack which gives the Vic 64K RAM.

It uses the technique of bank selection to switch in different banks of memory into one area of the memory map. When the cartridge is plugged in 24K is directly visible to Basic; a further 40K can then be accessed by switching in blocks of memory, 8K at a time.

The cartridge has been developed by Electronic Supplies, Utrechtseweg 129, 6812 AA Arnhem, Holland. In this country it will be sold through the Spectrum dealer chain for £100.

Accessing an 8K bank involves Poking the bank number into a single memory location. Should you feel cramped with 64K there is even a possibility of creating 152K RAM with two 64K cards, one motherboard and a few standard expansion cartridges.

Stack Commodore Supercharger Lines, Circles and Fills



STACK COMPUTER SERVICES has combined the facilities of the Vic-20 expansion units, Vickits 1 and 2, in one cartridge, the Supercharger Plus. Vickit 1 is Stack's version of Commodore's Programmer's Aid; Vickit 2, like Commodore's Super-Expander, supplies a high-resolution graphics mode with commands such as Line, Circle and Fill.

As well as incorporating all the commands from both kits, the Supercharger Plus includes an extra 3K RAM and allows 8K and 16K RAM packs to be connected. It costs £49, or £45 without the 3K RAM.

Also available from Stack is a 40/80 column board for the Vic-20. This gives a 40-column monochrome display on a TV or 80 columns on a monitor. It costs £115 from Stack Computer Services Ltd, 290-298 Derby Road, Bootle, Liverpool L20 8LN. Telephone 051-933 5511.

YOUR COMPUTER TOP 20

Game	Company	Machine
Flight Simulation	Psion	ZX-81
Games Pack	Sinclair	ZX-81
Frogger	D.J.L.	ZX-81
Mazogs	Bug-Byte	ZX-81
Chess	Artic	ZX-81
Time Gate	Quicksilva	Spectrum
Escape	New Generation	Spectrum
Mazeman	Abersoft	Spectrum
Ground Attack	Siversoft	Spectrum
Arcade Pack	Control Technology	Spectrum
Spectres	Bug-Byte	Spectrum
Hoppit	Commodore	Vic-20
Bonzo	Audiogenic	Vic-20
Defender	Rabbit	Vic-20
Jumbo Pilot	Thorn EMI	Atari
Pac-Man	Atari	Atari
Star Raiders	Atari	Atari
Meteors	Acornsoft	BBC
Space Warp	Bug-Byte	BBC
Ghost Attack	Dragon	Dragon

YOUR COMPUTER BACK ISSUES

Just getting started in computing? Or perhaps you're already pretty knowledgeable and would like to extend your programming skills. Either way Your Computer back issues can help to fill your need for reliable and, above all, relevant information about home computing.

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January 1982
Reviews: BBC micro; Wordprocessing on Atom; Morphy v. Champion (chess computers). Game — Treasure House. Education — ZX81 programs for school use. Vic-20 Software. ZX81 Graphics. A-D conversion. Interview — Kenneth Baker.

February 1982
Survey: ZX Software. BBC Graphics. ZX81 Animated Graphics. Vic 20 Music. Game — Dominoes. How to write chess openings. Atom Programming. Rubik's Cube on ZX81. Interview — Kerr Borland.

April 1982
Survey: ZX Ports. Sorting on ZX-81. BBC Graphics. How to write an Adventure Game. Atom line labelling. Game — Nim for ZX81 and Apple II. Interview — John Baxter.

May 1982
Survey: ZX Software. How to write a chess program. Games — Vic 20 Tank Battle; Magic Squares. How to show off your ZX81. Joysticks for the ZX81. BBC Graphics. How to write a word processing package. Interview — Richard Turner.

June 1982
Reviews: Sinclair Spectrum; Vic 20 Software; ZX-81 Keyboards. Games Vic 20 Mars; Othello on Flexidisc. Atom Utilities. ZX81 machine code monitor. How to build a portable computer. Interview — Ron Bissell.

July 1982
Survey: Atom Software. Spectrum Graphics. ZX-81 Colour Board. Games — Dog Race; Genie Guessing Game; Simon Challenge. BBC Sound. ZX-81 Dis-assembler. Programs for ZX-80. Interview — Richard Altwasser.

August 1982
Review: Dragon 32. Survey: Vic memory expansion. Spectrum Sound Games — Demon's Domain; Vic Duck Shoot. ZX-81 machine code (Part 1). Atom file handling. Ecological modelling. BBC techniques. Interview — Tony Baden.

September 1982
Review: NewBrain. Spectrum Software. Sound on ZX-81. Games — Vic Dambuster; B-52 Bomb Run. Vic-20 Assembler. Spectrum Disassembler. ZX-81 Indexer. ZX-81 machine code (Part 2). Midwich MC control computer. Interview — Hermann Hauser.

October 1982
Reviews: Sanyo PHC range; MPF-II; Commodore 64; Colour Genie. Survey: BBC Software. Atom Forth. Pascal for Basic users. ZX word processing. Games — ZX-81 Pinball; Vic Catacombs. Atom text. BBC control Key. Spectrum Assembler. ZX-81 machine code (Part 3). Interview — Douglas Adams.

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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

Spying on the Cheltenham HQ





Just yards away Britain's top spies are hunting for moles but Simon Beesley finds Cheltenham's computerniks are still in league with the badgers.

CHELTENHAM AMATEUR COMPUTER Club meets at Prestbury Scout HQ along the road from GCHQ, the government's electronic eavesdropping centre and scene of the recent spy scandal. GCHQ is probably the largest employer of computer personnel in the district but hopes that some of them might make an appearance at the Scout HQ were frustrated — the centre has its own microcomputer club, a BBC users' group.

The Cheltenham club passed through a fallow period when they were uprooted from their normal premises in a local technical college. They tried to run weekly meetings from an annexe which closed at 8.30. Attendance flagged as a consequence.

Matters have improved now that they are securely lodged in the scout hall. A notice above the entrance to the hall bore the ominous legend: "Due to rain damage all members must keep off the roof". *Your Computer's* representative did not enquire whether this referred to the club's normal proceedings. Certainly at this month's meeting none of the 15 members attending showed any inclination to start climbing.

Peter Manolescue of The Business House, Gloucester demonstrated the Sirius, the 16-bit business micro. Computer clubs often invite dealers to demonstrate their machines. The drawback to this is that dealers are unlikely to take the most objective view of the machines they sell and usually cannot give as good a review of them as the experienced user.

Nonetheless Peter Manolescue gave a lively demo which developed into an informal discussion. Conversation ranged over the use of micros in schools, the merits of word processors and the future of keyboard input. Members showed particular interest in the high quality graphics which the 800 by 400 resolution of the Sirius permits.

Also on show was the HX-20, Epson's very impressive portable computer. It had been brought down from Compec that morning and at the Prestbury Scout Hall was making one of its first public appearances in the provinces.

The Club's members display a range of computing interests. Steve Smith has built a home micro around a Z-80 processor which runs Tiny Basic in 2K. Although his attempt to make a teletext adaptor for the micro failed, he has successfully built a thermal printer for it using wood for some of the parts.

Vera Naumann, deputy head of a local primary school, bemoaned the lack of adequate software for schools. She had just written her first educational program on the BBC Micro, a music multiple-choice test. Her next move is to include sound in the program when she has mastered the complexities of the BBC's Sound and Envelope statements.

Club meetings are usually based around a talk or demo. They also hold meetings devoted to members' micros and programs. A BBC night is planned following the success of their Sinclair night held earlier this year. Further information from Mike Hughes (Cheltenham 75213).

Local society news

Harrogate ZX users

THE HARROGATE ZX Users' Club meets fortnightly at the PHAB Club in Mornington Terrace, Harrogate. Although they are primarily interested in Sinclair micros they welcome other users. Contact Peter Richmond, 7 Dragon Parade, Harrogate HG1 5BZ.

Bolton computer club

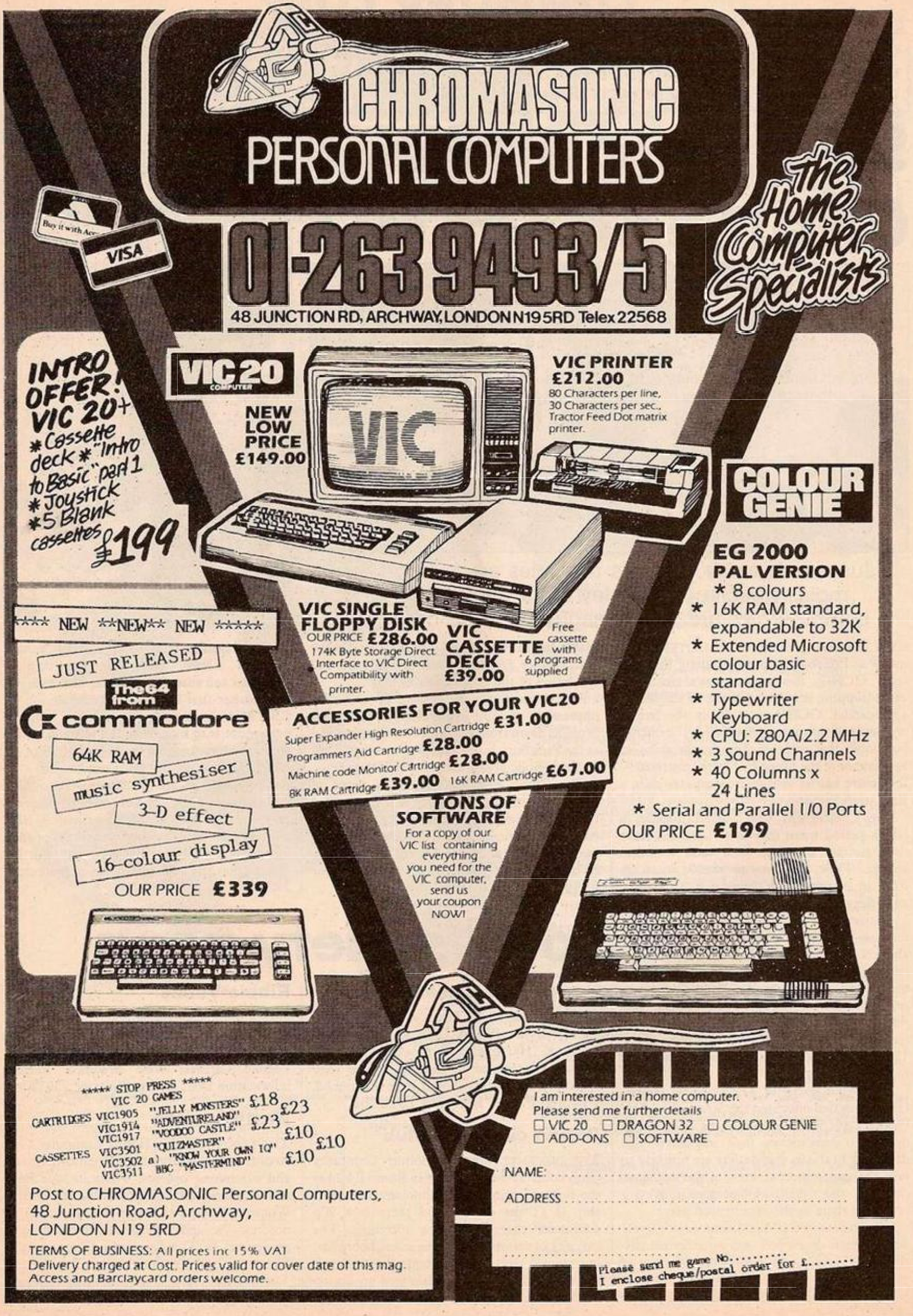
THE RECENTLY-formed Bolton Computer Club holds weekly meetings in Room E4/24 at the Bolton Institute of Technology. Membership is £1 per annum and there is a 20p admission charge at some meetings. The majority of members are home micro hobbyists, but anyone who has any computing interests can attend. Contact Roy Mumford on Bolton 493682 or Dave Atherton on 0942 876210.

Ribble Valley

THE RIBBLE Valley Computer Club is a new club in North Lancashire. They meet on the second and fourth Mondays of the month at Pemble Carpets, West Bradford. Further information from Ian on Clitheroe 25933.

North London

THE NORTH London Hobby Computer Club co-ordinates a number of different user groups and computing courses. These include Basic and machine-code programming courses, a Women's Computer Group, and meetings for novices, Vic and Sinclair users. Send for a prospectus to The Secretary, Department of Electronics and Communications Engineering, The Polytechnic of North London, Holloway Road, London N7 8DB.



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RESOURCE

WHAT'S ON THE FOR HOME COM



LOOK INTO the window. The year is 1993 and the only place you can find anything remotely like the micro you had in 1983 is an antique shop.

You pull out of your pocket a credit card-sized communications, information and resources centre and ask it why anybody bothered with home computers when the only way of communicating with the beast was to type in instructions by hand, or use a crude joystick.

After a discernible pause while the resource centre tries and fails to work out whether you were just being sarcastic, some archive film of the early days of home computing appears on the resource card's screen while a patronising commentary tells how the pioneers struggled against insufficient memory and bug-ridden programs back in the days when men were real men and RAM wobbles were real RAM wobbles.

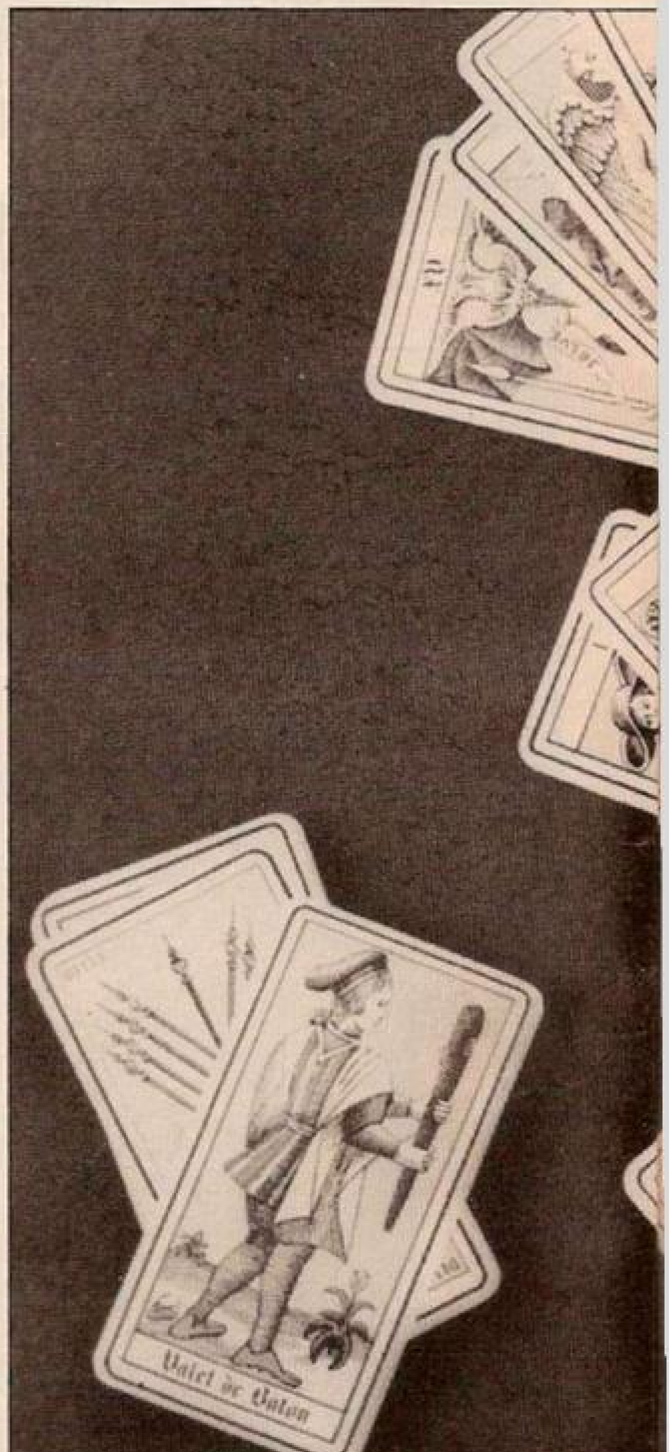
1983 marks a turning point in the history of home computing. In February the number of micros in Britain will break the million barrier for the first time. Over the course of the year the introduction of cheap mass-storage systems and telecommunication links between micros and databases will make cheap home computers into useful working tools, while both the hardware and software to be introduced over the next 12 months will make today's computer games look positively stone age.

Now that home computers are here to stay, it is time to consider how they may develop over the next 10 years. Other than looking at tea-leaves there are three ways of assessing this. It is possible to extrapolate present design trends and combine them with what individual information companies are planning as their next products. Such is the speed of advance in microcomputing that this becomes impossible for time spans of more than a year ahead.

Secondly, if your examine the continuing improvements of silicon chips and the research into even faster and more compact computing units, organised in superior ways, you can make a reasonable estimate of the crude power of the home computers of the 1990s. Thirdly 10 years is roughly the timelag between the first laboratory experiments on a theme and its general introduction. Computer games were being played in laboratories in early 1960s but it was 1972 before the first one — Pong — appeared on general release.

Likewise the personal computer was developed in the mid-1960s but it was 1975

TOMORROW'S TECHNOLOGY



before Steve Wozniak founded Apple. On that basis the laboratory research work carried out between 1973 and 1983 should give a clue to what will be commercially available before 1993.

In general, computer hardware produces 10 times as much for any given price as it did three years ago. This trend has been consistent for the last 30 years so we can expect the 1993 model to be 1,000 times as powerful as today's machines. Although software develops much more slowly, for the first few years micro software can jump a stage. As they grow more like minis and mainframes in their power they can adapt off-the-peg suites of programs written for their larger relatives.

The first major step forward this year is as old as the disc, but the widespread intro-

RESOURCE

THE SKY'S THE LIMIT
Micro power jumps by a factor of 10 every three years. This exponential rate of growth makes 1993's home computer 1,000 times more powerful than 1983's.

CARDS
PUTING ?

RESOURCE

Hollywood took 30 years to turn black and white silent movies into colour talkies. The home micro industry has managed that in just three. Meirion Jones dons his gypsy scarf and gold ear-rings to look ahead at the next 10 years of home computing.



duction of 3in. and 3.5in. microfloppy drives for between £150 and £200 will make mass-storage systems accessible to home computer owners. By 1984 the price of a drive should be less than £100. At the lower end of the market Sinclair's Microdrive when it finally appears should be a great improvement on present cassette-based systems.

Video discs are also becoming a fashionable storage medium because of their ability to illustrate interactive games, promotions or education programs with real film. Philips Laservision can store the equivalent of 54,000 still TV pictures on one disc. Sony has already released its SMC-70 video disc-based computer system in America, where Ford and General Motors both use similar video-disc computer systems to sell cars. In Britain one firm is selling an interactive video disc-based system to teach medical staff how to diagnose illnesses.

At present the cost of such systems is prohibitive but there is hope.

In March Philips and Sony hope to wipe out the market for conventional LPs by launching a new 4.75in. laser disc and player. Already some record manufacturers plan to use the laser discs for a screen display to go with the record. It would be comparatively easy for software houses to put their programs on these new Compact Discs and incorporate real film sequences in interactive adventure games. Projected prices are in the region of £10 per disc, and although the players will originally cost £400 once they start selling in numbers prices will drop below £200.

1983's real innovation though will be communications between micros at a reasonable price. In February Oric will start delivering £60 Modems to fit on the Oric 1. This will make it possible to buy a colour computer and a Modem together for less than £160. Micronet 800 is another scheme to deluge computer owners with relatively cheap Modems, which starts this month. Before the summer Sinclair also hopes to join the Modem-makers' club.

In each case the motivation behind the scheme has been to sell software which can be downloaded from the phone much more cheaply and conveniently then by buying a cassette or cartridge and loading that in. If the technology is taken advantage of, it could be used to connect your home micro to vast databases containing most of the information you could ever need. You could send and recieve electronic mail to and from anyone else with a micro and a Modem. You could play interactive computer games against an opponent who might live in another city.

As 1983's home micros become more competent a new type of software will emerge to take advantage of the possibilities. Sinclair hopes to introduce a home doctor on the ZX-83 which will ask the patient what his or her symptoms might be before sorting through a base of information to eliminate most possibilities and following up likely leads with more questions.

At the end of the "surgery" the computer would produce a list of possible causes of the symptoms in declining order of probability. Such an expert system could be described as exhibiting artificial intelligence — a term which will be ruthlessly exploited and twisted out of all recognition by computer product sellers.

There is already an adventure game for the Spectrum called The Hobbit which the publishers describe as having AI. To be fair the adventure is apparently every bit as imaginative and entertaining as the publisher's claims for it.

Atari's Chief Scientist Alan Kay believes that however good the hardware is, home computers will never reach their potential unless Basic is discarded. Despite the evidence he thinks that for every child who takes to programming with enthusiasm there are a dozen who are put off by the time it takes to produce anything interesting in Basic.

"The last thing we want to do is bring up a generation of kids who hate computers because they had to learn Basic." Equally he has little faith in the "grown-up" languages which he thinks will become available on home computers over the next two years. Kay developed Smalltalk — a tool-building language which encouraged the young to make maximum use of the computer's capabilities, and which has recently become available on the larger micros. Soon it will migrate to the home computer.

Making the most of manipulative languages will mean that the home computer will start to acquire a whole new paraphernalia to make the user interface more friendly than a keyboard.

It is already quite simple to persuade a modern micro to respond to a few simple spoken commands. The computer does not

(continued on page 37)

(continued from page 35)
have to understand anything about meaning to respond to clearly-spoken, single-word commands — Speak to your Spectrum *Your Computer* November 1982. As home computing becomes more popular though, the temptation to do away with input through the keyboard will increase.

Even on mainframes the problems of recognising a word out of the stream of noises humans make when they are communicating with each other have not been totally solved. We distinguish similar-sounding words according to the context in which they are spoken. Until we start building computers which have somehow soaked up the same sort of picture of the world as the people talking to them, context will still prove a problem. Meanwhile much of the most successful work in speech recognition is classified because of its obvious defence and security applications.

Computer-generated speech is by contrast now a much easier problem. The Detroit dalek sound is aleady a thing of the past. Acorn's Kenneth Kendall speech chip is only the first of many voices that will humanise the sound of silicon.

Despite the low price and apparent appeal of the light-pen most computer-makers believe that a more modern approach is necessary. Sinclair for instance was considering making a light-pen available as an accessory but now research is concentrating on building complete systems of software and hardware designed to make the use of computers as easy as pen and paper.

One approach which the home computer-makers are thinking of borrowing from the minis is the mouse. The mouse itself is small and hand-held and can be moved around on the desk very much like a pen on paper. It produces a cursor on the screen which moves around as the mouse is moved across the desk. A few single controls on the mouse are enough to move sections of text or a design around on screen. In future the mouse could also be designed to read in text as required from a sheet of paper on the desk. At present even on minis the mice are connected by wire or fibre-optic link to the computer. The mouse will become far more effective once the physical connection can be discarded.

Since 1975 the home computer has changed out of all recognition but the television display which the user relies on has improved very little. Essentially the television or monitor is still the heavy box which it always was, displaying a small picture which you have to stare at. Now advances in flat-screen displays are changing all that and making light-weight, portable computers with built-in screens possible. Before the end of the decade it will be possible to produce a pocket-sized computer which could project a wall-sized display.

Sinclair's much delayed flat-screen project will be producing pocket televisions by next spring. We can expect flat screens to appear not only in Sinclair's computers over the next few years but in many others. The Japanese seem to favour large liquid-crystal displays for their flat screens but Sinclair relies on a flattened cathode ray tube with the electron gun displaced to one side. By 1984 he envisages making a 4ft. colour flat-screen television. You could then hang your game of space invaders, or a flight simulator, on the wall.

The shape of 1983

The machines released this year will offer more for less and are likely to come with useful applications already on board — there are hints that Sinclair's ZX-83 project may come with a built-in word processor. Price cutting will continue — the ZX-81 or its equivalent could cost £25 complete by the end of the year and Binatone insists that it is still going ahead with the £50 colour 16K micro despite delaying the launch from January to March.

Now Binatone plans to launch two other machines at the same time as the £50 Micro. Acorn hopes to finally launch the £150 Electron in February with a portable version to come in the summer. Portability will be an important theme this year. Sinclair is keeping his cards to his chest but the features he has previously mentioned — Sinclair Interview November *Your Computer* — still suggest that a small briefcase computer is a likely shape for the ZX-83. Nigel Searle, Sinclair's Research Director, will only say that while the Spectrum evolved from the ZX-81 the ZX-83 "will enter a new section of the market."

Apple is considering launching a new machine in the £200 price band, and Mattel makers of the Intellivision may hot up the competition with a £100 Spectrum contender. Commodore is again threatening to release the Max games machine at £100.



Grid's Compass points the direction for 1983.

By the end of the decade computer enthusiasts will be expecting their machines to be throwing up realistic three-dimensional displays. It is unlikely that people will still be prepared to sit and wear red and blue glasses night after night — although one American company is producing arcade computer generation games which do require this — so, much research is proceeding into three-dimensional display.

Holographic techniques offer some promises in the long term but in the meantime the problem of three-dimensional display has produced some ingenious ideas. In America a laser has been used to illuminate rapidly rotating panels to give an illusion of depth. Rudiger Hartwig of Heidelberg University is using a variation of this to create a real three-dimensional display. A helix in a column spins at high speed while a laser illuminates it from above. By deflecting the beam across the helix at high speed an apparent line can be created inside the column. An electro-mechanical deflector is sufficient at present to generate lines, spirals and helixes in the column. Eventually Hartwig will use three lasers to produce colour with electronic deflection to speed up the process and hence produce higher definition.

In the late 1970s Massachusetts Institute of Technology used a mainframe to simulate the order of computing power which would be available in the home by 1990. A system called Dataland was developed which allowed the computer to go soft. You just had to sit in an armchair in front of a wall-sized TV display showing everything from a pocket calculator to a phone and a photograph album. Either using your voice or just pointing you could choose an item off the wall and then control it either on the wall display or on a small monitor by your chair.

To make a phone call for instance you would ask for the phone — which need never appear as a hard object — and when it appeared on your monitor you could have the choice of dialling the number yourself by pushing the buttons as they appeared on screen or by asking the computer to find and dial the number of a particular person for you.

If you chose to look at your photo album you could direct the computer with the minimum of fuss to blow up any picture you might want across the wall. Such a system with built-in word processors and expert diagnostic systems would hold a database of all the information in your house, making it easily accessible. It would also have links with large external databases in case you wanted information it did not have.

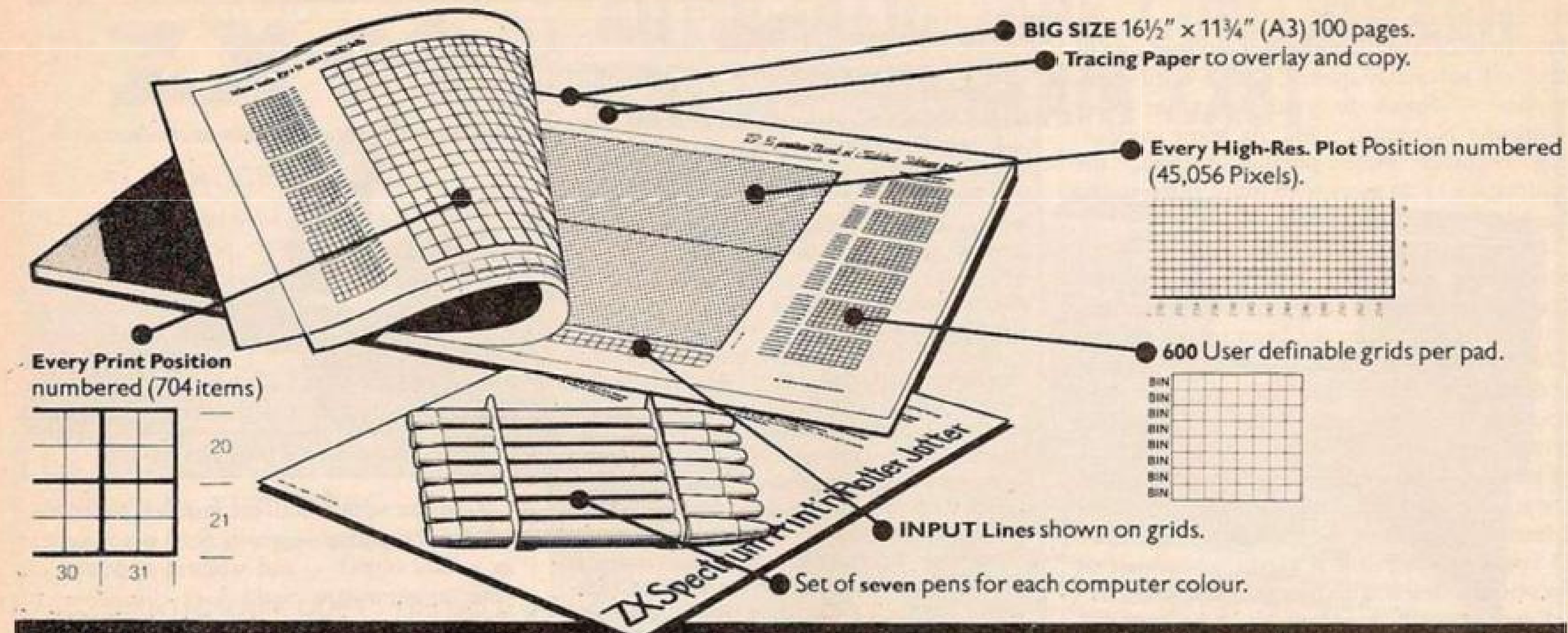
This computer would also be the entertainment centre for the home. Not only could you ask it to put on a particular television program but you could ask it to find and show an old film — downloaded from a rental agency.

All this depends on microtechnology continuing its exponential growth. All other things being equal there are two ways to make chips which will produce more computing power for less money. Either you must increase the speed at which the individual components, or logic gates, on the chip switch, or you must fit more of them on to a chip.

At the moment 250,000 gates can be fitted on to a single 10mm. square slice of silicon but new photographic techniques are increasing this density all the time. Hewlett-Packard now believes that such a slice could support the million gates needed for a 64-bit processor.

Meanwhile the military in particular are examining the possibility of using gallium arsenide instead of silicon to produce chips which will work five times as fast. In Britain the acronym-happy Ministry of Defence is funding the VHPIC programme to produce very high performance integrated circuits — while the American Defense Department is spending $200 million on VHSIC — developing circuits which will be 100 times as fast as present.

Although these developments take time to filter down from military to commerical use, — from the killing business to the business of making a killing — the time lag before new wonder chips appear in micros is decreasing all the time. As the U.S. Commissioner of Customs put it, with unnerving enthusiasm "The same technology which brings us the
(continued on page 39)



It will improve your ZX SPECTRUM graphics in ways you wouldn't believe possible.

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Printed on high-quality tracing paper, enabling you to overlay the pages for direct co-ordination between PRINT and PLOT or to copy from illustrations, maps, charts, photos etc.

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(continued from page 37)
likes of Pac-Man is scaring the hell out of our enemies."

Beyond 1993 the possibilities become more exotic — home computers which could in some way be described as alive. Plant matter will reappear in micros for the first time since Commodore gave up making Pets in wooden cases. The American bio-technology company EMV Associates hopes to produce biochips by the end of 1983. Using an electron beam EMV plans to deposit microscopic circuit designs on to protein. As the circuits will operate in three dimensions they have a potential capacity 10,000 times greater than their silicon equivalents.

It is not only the materials of which the insides of the computers are made which may become more biological. Technologies which begin to look more like the organisation of living creatures than machines are being developed.

Human beings have a nervous system made out of components which are inherently much slower than those of a computer but because of the way that the system is organised even the most powerful computers may never be able to compete with human beings in reacting intelligently to stimuli if they have to cope with inputs serially.

Parallel processing could speed up computers by many orders of magnitude and make them easier to interface to the real world. Parallel processing has always proved impossibly difficult to implement up to now but one British researcher expects to demonstrate a working system this year.

Is there life in biochips?

The concept of a living, self-replicating, computer existed in the realms of science-fiction long before companies like IBM and Genex began to intimate that a microchip with a biological, rather than a purely chemical basis, was a possibility under serious research.

A team at Warwick University, headed by theoretical physicist John Barber, is working on a biochip design that could be implanted in the human body. It would monitor minute changes in the calcium ions as a result of heart muscle action, thus providing early warning of a heart attack.

It may one day be possible to use chips to correct electrical signals in the human body, sorting out damaged nervous systems. After serious operations, such as open-heart surgery, or where the patient is under intensive chemotherapy, it is useful to monitor the body's potassium balance as this is linked to neural disorders. Since potassium produces ions in electrolysis a microchip could be implanted to perform the function of an electrode, thus measuring the level.

What does Dr Robertson of Edinburgh University, recipient of a £1.78 million SERC grant for microchip research think of the "natural" biochip? "That technology will add something new to our capability. The interesting thing will be to see the integration of our new organic materials with straightforward silicon material."

While Dr Robertson is involved with the straightforward silicon materials, Professor Gareth Roberts and Dr Mike Petty at Durham are in the forefront of making Langmuir Blodgett films — a basic technique in biochip technology.

To make a Langmuir Blodgett film, first take a long-chain organic stearic acid with a carboxyl group of molecules at one end and a methyl group at the other. A soap film is a good example. Put it on the surface of water and the carboxyl group floats — the other end sinks. So the film's molecular chains point upwards. By applying lateral pressure you can form a raft. This can be pulled off on a substrate, making a chip which is thinner and more efficient than the all-silicon ones — the film is only one molecule thick.

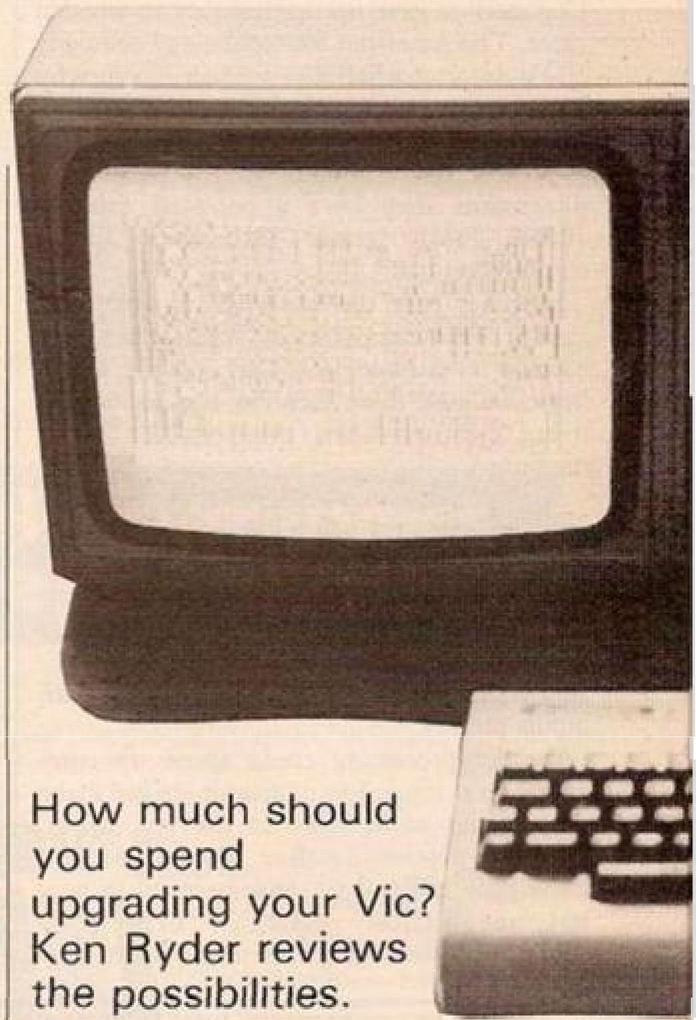
The departure from silcon is significant. Silicon oxidises easily, hence its current popularity for microchip construction when compared with more trickly substances like gallium arsenide or indium phosphate. But if these Langmuir Blodgett techniques are successful they may sound the knell for the seath of silicon.

In Japan biological computers are taken seriously enough to form part of the plan for a fifth generation of computers. The Research Development Corporation is funding Hiroshi Shimuzu who has coined the term bioholonics, or the study of self-organising life phenomena, to describe his research. Many experts predict that by the end of this century computers will need to combine biological organisation with biological materials. ■

Super Expander commands

Auto — displays and increments line numbers automatically. The user can specify the starting line number and the interval between lines, if not then the starting line defaults to 100 and the interval to 10.
Renumber — automatically renumbers all the program lines including the Goto and Gosub references, starting at the line number specified and at the increment set by the user.
Delete — can delete a single line, or all the lines specified between a starting and finishing point, or all the lines from a starting point to the end of the program.
Find — searches the program for a specified Basic command, character, or character string, and displays all the lines in which it appears.
Change — searches for a Basic command or character string and replaces it with a new command or string.
Edit — changes from program mode to edit mode, which alters the function key commands.
Key — allows the user to alter the commands assigned to the function keys. The information assigned to any one key must be 10 characters long or less, and an automatic carriage return can be included in the function.
Help — displays the line in which an error has occurred during program execution and highlights the error in reverse characters.
Dump — displays all the variables and their values in the order in which they were defined, except those in arrays. The value of a variable can then be changed by over-writing it.
Trace — displays the program line number as it is being executed in a small window at the top right-hand corner of the screen. The Shift or Ctrl keys slow down the display if it is too fast. This is useful for finding infinite loops within a program.
Step — halts the program after each program instruction, displays the line numbers associated with that instruction and the first line number of the next instruction. The Shift or Ctrl keys cause the next instruction to be executed.
Off — cancels the Trace and Step modes.
Prog — changes the assignments of the function keys to normal Basic commands.
Merge — loads a previously stored program or subroutine from disc or cassette and incorporates it into the program already in the Vic's memory.
Kill — cancels the functions of the cartridge, but leaves the assignment of the function keys unaltered. It is necessary to inhibit the cartridge during normal program operation because memorising information for diagnostic messages such as Help increases execution time.
Ctrl A — scrolls up a listing.
Ctrl Q — scrolls down a listing.
Ctrl L — blocks out all the characters to the right of the cursor on a line.
Ctrl N — blocks out all the characters on the screen after the cursor.
Ctrl U — blanks out the line on which the character is positioned.
Ctrl E — inserts information between quotation marks on a program line.

VIC-20 ADD



How much should you spend upgrading your Vic? Ken Ryder reviews the possibilities.

IF YOU WANT to upgrade your Vic-20, expanding the memory must be a priority. A screen expansion and some aids to programming in Basic and machine code are also often near the top of Vic-owners' shopping lists once they have tired of cartridge games.

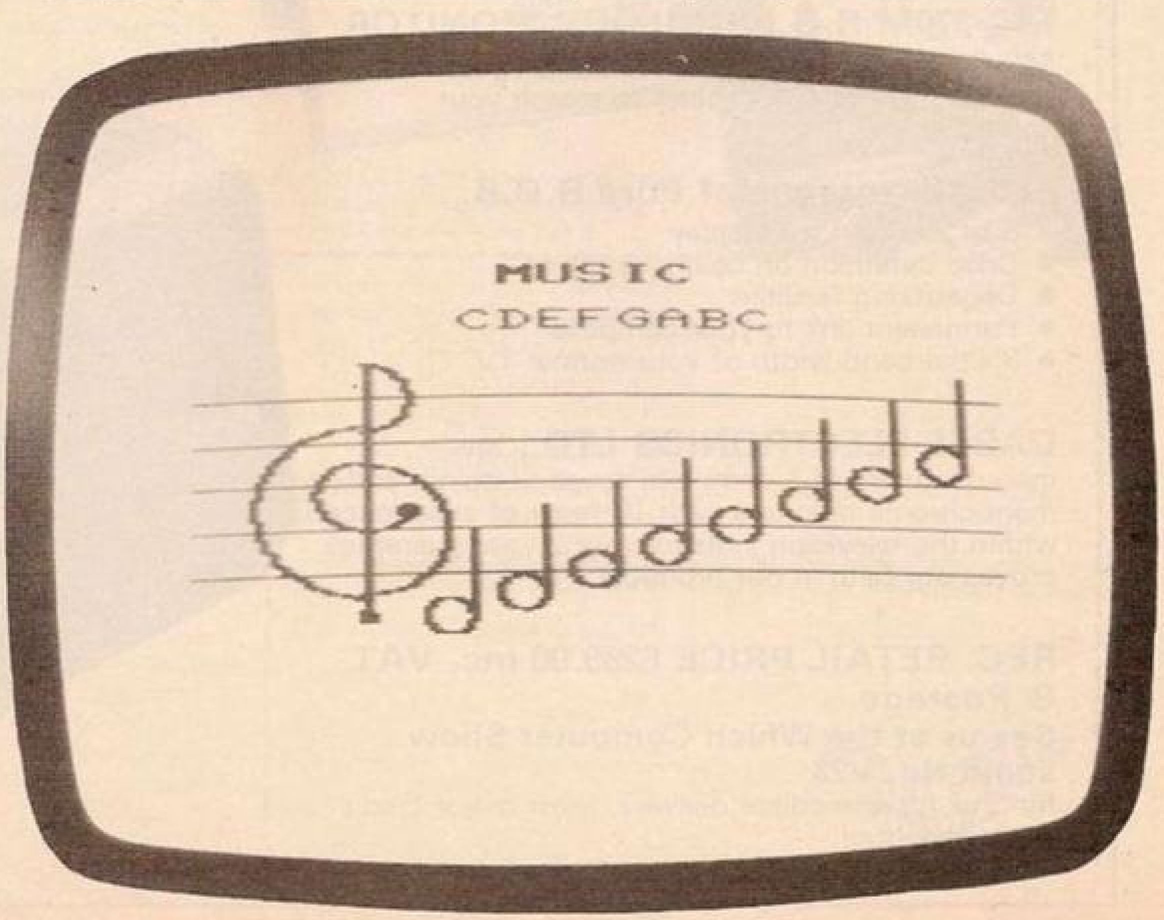
With the Commodore expansion system a 3K, 8K or 16K memory pack can be plugged directly into the back of the Vic to give a maximum on-board memory of 21K, 19.5K of which is available for Basic programs. In order to expand to 32K a motherboard with six expansion slots can be plugged into the back of Vic allowing the 3K, 8K and 16K cartridges to be used together. This leaves three slots available for utility cartridges such as the programmer's aid, machine-code monitor, and games packs.

When the Vic has been fully expanded to 32K only 27.5 is available for Basic programs because the area of memory occupied by the 3K RAM pack is no longer used. However, it is still available for storage of machine-code programs, and for Peeking and Poking values to, so you could store an alternative character set or several screens of information there.

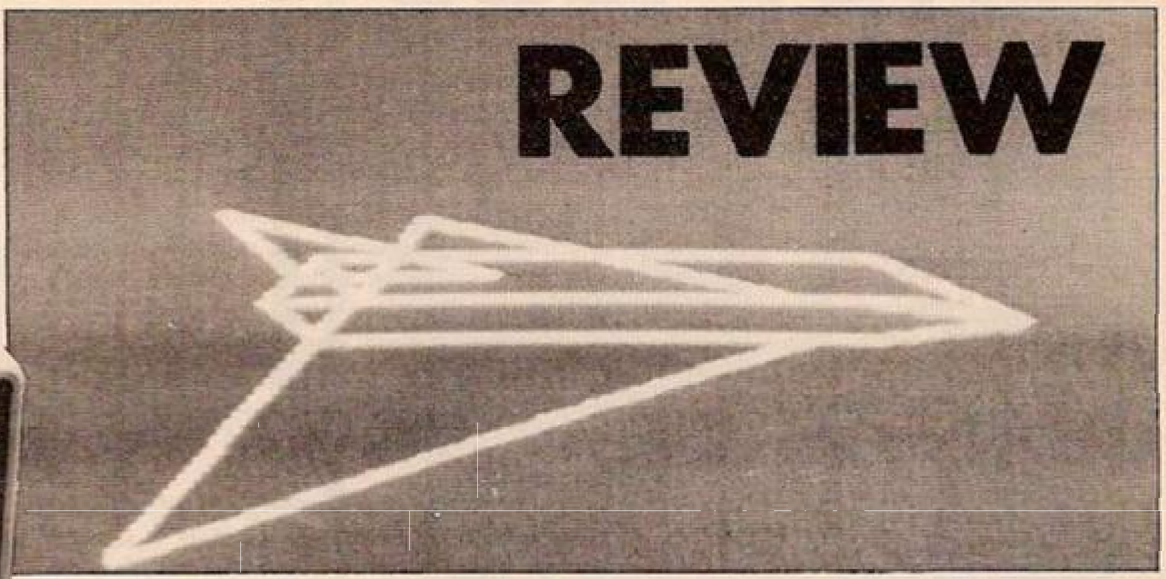
One of the main criticisms of the Vic is its 22×23 screen display, and a 40-column option has been long awaited. The Beebox was one of the first attempts, but was expensive and the manufacturer has now gone out of business. Stack Computer Services has stepped into the breech with a 40/80 column × 25 row monochrome card.

As soon as Commodore's Super Expander cartridge is plugged in you have 3K of extra RAM. The function keys assume eight single keystroke commands, which you can redefine if necessary. Nine new Basic commands are available for plotting and colour control. Eighteen commands become available for the production of sound and music, and seven for reading values of sound and colour registers, including inputs from devices connected to the games port such as joysticks and light-pens.

The pre-assigned function-key commands



-ONS





are Graphic, Color, Draw, Sound, Circle, Point, Paint and List. These may be changed using the Key command to any 128-character string, including a carriage return if required. If you do not want to use those graphics commands in a program, the function keys could be used to enter standard Basic commands instead such as Next, Goto, Print, and Gosub.

Unfortunately, the cartridge does not use the highest resolution available on the Vic, 176 × 184, but reduces the screen area slightly to 20 rows by 20 columns, giving a maximum resolution of 160 × 160. Presumably Commodore did this to reduce the screen memory overhead. Then for some reason they divided the screen into a 1024 × 1024 co-ordinate system with its origin in the top left-hand corner of the screen. As there are only 160 × 160 possible plotting positions this means that several co-ordinates occupy the same pixel.

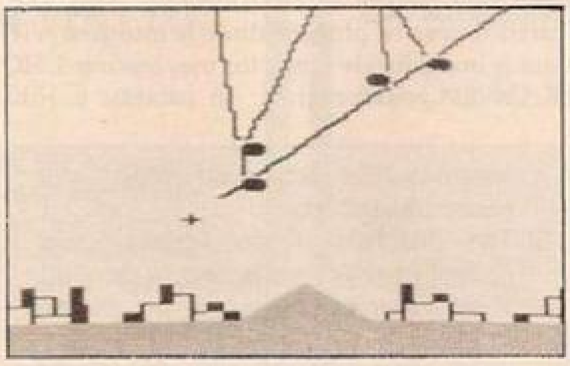
Graphic selects one of the four graphics modes. These are: normal text, medium resolution, 80 × 160, multi-colour graphics allowing any of the 15 colours on the Vic to be used, high-resolution mode, 160 × 160, allowing only the eight keyboard colours to be used, and high-resolution multi-colour mode which allows the mixing of the high-resolution and medium-resolution multi-colour options. All of the modes except normal text require 3K RAM for the screen.

There are four colour registers available and a number from 0-15 can be stored in each, specifying a colour. Register 0 holds the screen colour, register 1 holds the border colour, register 2 holds the character colour used for plotting points and register 3 holds the auxiliary colour which also can be used for plotting, but only in multi-colour mode. The Color command sets the values for these registers.

Point plots a point on the screen at specified co-ordinates. Several points can be plotted using a single Point command, but all will be the same colour. The colours available and resolution depend upon the graphics mode selected. Region changes the character colour, register 2, to any of the eight keyboard colours in high-resolution mode, or any of the 16 colours in multi-colour mode.

Draw plots a straight line from one set of co-ordinates to another, for as many points as can be specified in an 88 character line. It can also be used to plot lines from the finishing points of previously drawn shapes and circles. Circle is an extremely powerful command allowing the user to draw circles, ellipses and arcs on the screen.

Paint fills an enclosed area with a colour starting at specified co-ordinates within the area. If the co-ordinates are outside the area, or the area is not fully closed then the whole



screen will be painted. Again the colours available depend upon the graphics modes.

Char permits strings of text to be displayed on the screen whilst in high-resolution or mixed mode. This facility is not available in medium-resolution multi-colour mode. ScnClr — clears the graphics screen.

The number and range of colours available in each graphics mode is a little complicated. The screen consists of 20 × 10 double-height blank characters, and there is a colour block associated with each character. In multi-colour mode medium-resolution plotting can be performed in any of the colours specified in registers 1, 2 and 3 against the background colour of register 0 and any of the 16 colours can be entered in each register. Thus four colours can appear on the screen at one time.

In high-resolution mode plotting can only be performed in the character colour registers, and only the eight keyboard colours can be used. During a program the character colour can be changed using the Region command, but if two points of different colours try to occupy the same colour block such as two lines intersecting, some interference will occur. With careful programming it is possible to use all eight colours on the screen at one time.

In high-resolution mixed mode only registers 0 and 2 can be used for plotting, and all 16 colours can be specified. If the colour set in register 2 is one of the keyboard colours, all points will be in high resolution. If it is one of the other colours, plotting will be in medium resolution. Again if points of different colours or resolutions try to occupy the same colour block some interference may be produced, but with care it is possible to use all 16 colours on the screen at one time.

The music capabilities of the Vic are greatly enhanced by the Super Expander cartridge. The Sound command controls four voices and their volume, and can be used to produce two or three note chords. Each voice is allocated a three-octave range, which at first sight appears to give nine octaves. However some of the octaves overlap giving a five-octave range.

Entering Music Mode with the Ctrl and □ keys, converts keys A, B, C, D, E, F, G, #, $, P, Q, V, S, O, R. into musical commands. Keys A-G play the natural notes A-G. If # is pressed before the note a sharp is played, if $ is pressed before the note then the note is flat. V controls the volume of the note and R is a rest or silent period. The duration of the note or rest is determined by tempo, T. Any of the four "voices" can be chosen with S, and any of the three octaves in its range with 0. S302V5T9# A, plays A sharp of voice 3 in octave 2 at volume 5 for time 9; approximately 4 seconds.

All of the musical commands can be displayed on the screen by entering P, and this can be cancelled by Q. These commands can be entered directly at the keyboard, or they can be combined in a string and executed by a Print statement within a program.

There are also several commands which can be used to read the colour and sound registers, or test the condition of various peripherals

(continued on next page)

(continued from previous page)
that can be plugged into the games port. Rgr reads the mode set by the Graphic command and Rcolr reads the values of the registers set by the Colour command. Rdot reads the colour of any point on the screen and Rsnd reads the values of the four voice registers and their volume as set by the Sound command.

Rpot reads the values of any paddles or potentiometers connected to the user port and returns a number in the range 0-255. Rpen reads the X, Y, position of a light-pen on the screen and Rjoy reads the position of a switch-type joystick and its fire button.

Documentation consists of a 22-page booklet which describes each command complete with a small programming example. If you are thinking of buying a 3K expansion pack and want to use your Vic for graphics and sound, spend an extra £5 and buy the Super Expander cartridge — it is well worth it.

The Vic-20 Programmer's Aid Cartridge is a useful tool for writing, editing and debugging Basic programs. When first plugged into the Vic or expansion board it has no effect and must be initialised to gain access to the extra commands. This is achieved by Typing SYS28681 followed by the Return key. Those of you familar with the Vic memory map will realise that the area starting at location 28681 normally resides in an 8K block of RAM, if fitted. If you have a fully expanded Vic the last 8K block of RAM will be unavailable when using the Aid cartridge, allowing only Basic programs of 19.5K or less to benefit from it.

After initialisation the cartridge is in program mode and the function keys are assigned 12 useful Basic commands such as Goto and Gosub. Normally only eight function keys are available, the other four, F9-F12 are obtained by holding down the CTRL key and pressing the function keys. The Edit mode is entered by typing Edit, or by pressing the Ctrl and F1 keys together. In this mode the function keys are assigned special editing commands, which cannot be included in Basic programs such as Delete, Find and Step.

The function keys simply allow single-keystroke entry of commands and do not limit the commands available. The user can even as sign his own commands to the function keys if desired using the Key command.

The cartridge comes complete with a 15 page instruction book describing each new command, together with a short programming example. The final section uses a dice-throwing program as an example of how to write and debug a Basic program using the features of the cartridge.

Anyone writing long complicated Basic programs of 19.5K or less will find this cartridge invaluable. The time and effort saved in program development could soon cover the cost.

Vicmon as the cartridge is affectionately referred to in the documentation, is similar to the Programmer's Aid, except that it simplifies the writing and debugging of assembly language programs rather than Basic. Typing SYS24576 followed by a Return initialises the cartridge, again the last 8K RAM block is occupied by Vicmon.

The function keys are not assigned any values. Upon initialisation the screen displays the contents of the 6502 registers, that is the program counter, status register, accumulator, index register X, index register Y and stack pointer. The commands offered are single characters followed by various parameters such as start or finish addresses, op-codes, operands and hex values. In fact all operands must be preceded by $.

Vicmon should not be confused or compared with a full assembler/editor. It is a simple aid for the production of short machine-code programs or subroutines. For anyone who has tried hand assembly and a Basic loader for machine code this cartridge is heaven sent, reducing nervous breakdowns to a minimum. Although as all operands must be entered in hex, a decimal to hex conversion command would have been welcome, but I suppose you can't have everything.

At £35 this cartridge appears expensive when compared with some cassette-based assemblers, however, you are paying for the reliability of quality firmware. Also the cartridge can be plugged directly into your Vic and is immediately ready for use, leaving 3.5K RAM for your program. In contrast a 16K RAM pack may be required to load a good software assembler.

The documentation assumes the same layout as the previous cartridges. It is aimed at the reader who is familar with 6502 assembly language, but not an expert. The cartridge commands are presented in alphabetical order, leading to some page flicking, as some of the earlier commands refer to others further on in the text. Some important information, although obvious, is missing. For instance the M command can be used to create word tables or blocks of data as well as editing them; an example of the format required for each form of addressing would be beneficial; for conditional branching only the address to be branched to need be specified, this is only implied in an example; all two-bit addresses are entered MSB,LSB rather than LSB,MSB as in some assemblers.

Stack's 40-column card plugs directly into the back of the Vic or any expansion-board slot, and comes complete with its own video chip to control the display, 2K RAM for the screen memory, and the normal Vic/Pet character set in ROM. The card uses the Autostart facility of the Vic and if no action is taken at power-up the display is automatically in 40-column mode. Various key combinations during power-up will obtain the 80-column or normal Vic configurations. The display can be changed at any time, either directly from the keyboard or under program control.

The card comes complete with monitor and UHF output sockets, either of these together with the Vic's normal UHF output can be used to drive two separate televisions or monitors. For example a program listing or a table of results can be displayed on the 40/80-column screen whilst a graph is plotted on the other.

The card also offers a couple of other useful features. The screen can be set to give automatic line spacing, and if the normal Vic screen is not required the 1.5K memory normally allocated can be used for Basic program storage, also the lower 3K of RAM can be used for Basic giving the Vic a true 32K expansion potential. Obvious uses are word processing, communications, business applications and education.

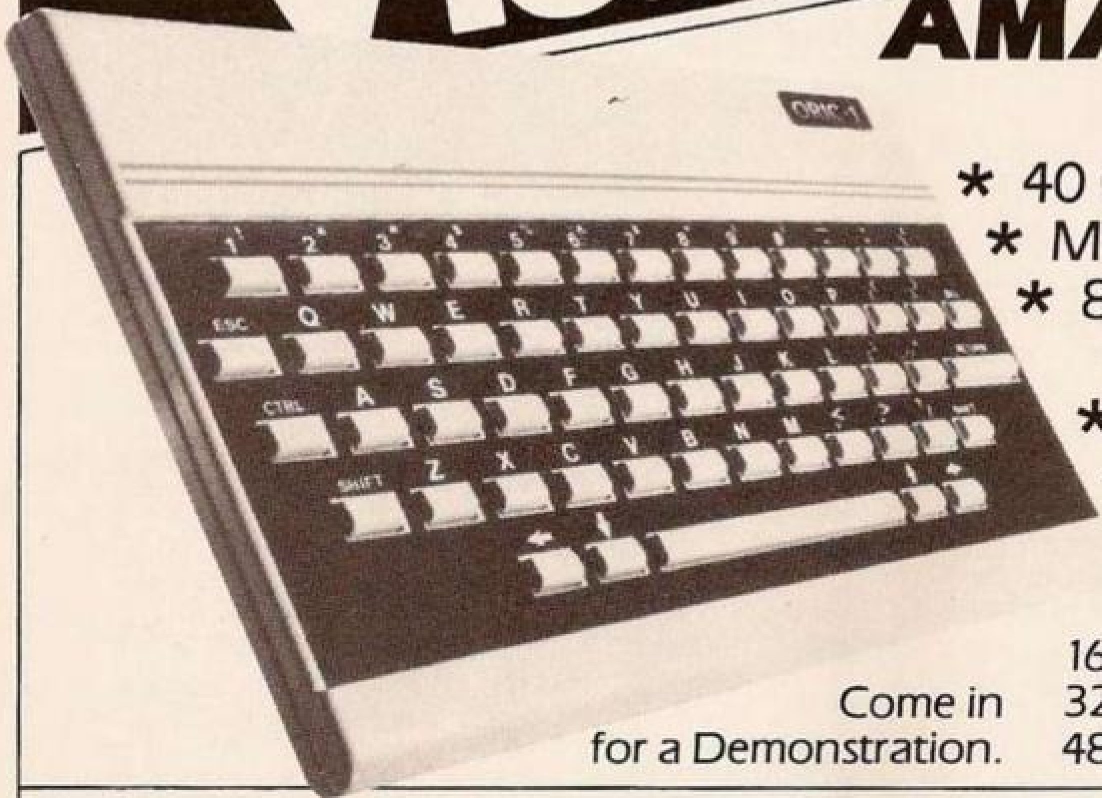
CONCLUSIONS

- Commodore's cartridges are well presented and constructed, the firmware is professional and bug-free.
- The approach of the documentation is far superior to that of the Vic-20 user manual, including contents, introduction, examples, summary and indices, but the demonstration programs could be better.
- The Super Expander Cartridge offers good value for money and should be purchased in preference to a plain 3K RAM pack. It would be a great advantage if the Super Expander functions could be included with 16K RAM instead.
- The Programmer's Aid offers many useful editing and debugging features, but can only be used to develop programs up to 19.5K in length. This limitation may well restrict its market.
- The Machine Code Monitor will appeal to anyone wanting to develop short assembly language programs. It falls nicely between the two extremes of hand assembly/Basic loader, and a full assembler/editor. The cartridge limits the maximum possible program RAM to 22.5K but this should be no real restriction to assembly language programs.
- Stack's 40/80-column board is a welcome addition to the Vic range of accessories. However, the cost, monochrome display and inability to give high-resolution graphics, 320 × 192, may fail to appeal to the home user market.
- Vic owners should consider their expansion plans carefully. If you are only interested in Basic programming and do not require high-resolution graphics, it seems pointless to buy a 3K RAM pack as it will not be available for Basic when expanding above 6.5K.
- Expanding above 19.5K may be a waste of money and RAM if you want to use the Programmer's Aid, because the top 8K of expansion area is occupied by this cartridge when in use. If you are only interested in assembly language then Vicmon may be all you need, plugged directly into the back of your Vic the 3.5K on board will go a long way.
- The Programmer's Aid, Super Expander and Machine Code Monitor each cost £34.95, 3K of RAM costs £29.95 and the Stack 40/80-column card costs £115. ■

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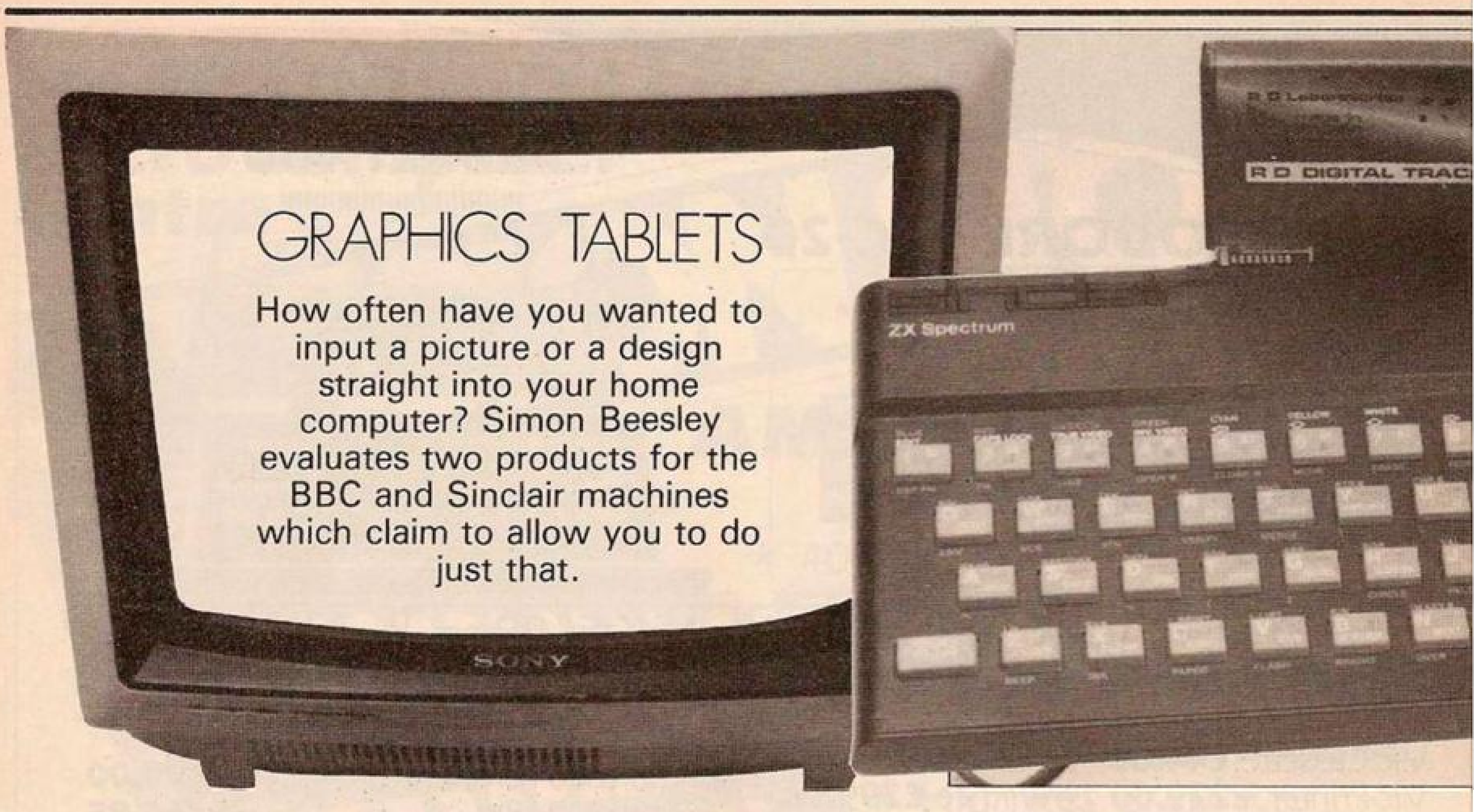
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GRAPHICS TABL

THE RD DIGITAL TRACER enables pictures to be drawn or copied to the Spectrum's screen. It consists of a mechanical arm which is hinged at the base and the middle and can be mounted on a drawing board. At each joint of the arm there is an angular transducer. Signals sent by the transducers are digitised by an interface board, plugged into the rear of the Spectrum. The board has a connection to take a ZX Printer or Microdrive.

The kit also includes a software cassette, an instruction booklet, a tracing sheet and a template for aligning the tracer with the tracing sheet.

Drawing program

Once you have loaded a drawing program you can transfer a picture to the screen by moving the head of the tracing arm.

Probably the most important question to answer is how easy is it to transfer an outline to the screen accurately. The tracer picks up movements within an area 30cm. by 20cm. Since the Spectrum's resolution is 255 pixels by 175 this gives just over a millimetre per pixel. The arm certainly responds to movements this small, but achieving an exact screen copy depends more on how much fine control the arm's action allows.

As with a joystick, the problem is to strike a balance between too much give and too much resistance: few people can manage to control a joystick steadily if it moves too freely, and, on the other hand, too stiff an action is equally likely to result in jerkiness.

The RD Tracer scores quite highly in this department. Although the action is fairly free you can steady its movement by putting pressure on a pencil inserted in the tracing head.

Four programs are included on the software cassette, which can be used alone or merged together. The main drawing program provides a number of plotting options and also allows you to use Spectrum Basic's plotting functions. Single-letter entries allow you to plot individual points or draw a continuous line, change the background or foreground colour, delete lines and print text. Among the other options is a facility for filling in or shading the area enclosing the tracer. The position of the tracer on the screen can be indicated by a small or large crosswire.

You can draw a circle using the Spectrum's Circle command and define the centre and radius through the tracer position. The Spectrum's facility for saving the screen to tape is also available.

The plotting modes

These and other plotting modes enable you to copy a picture to the screen as closely as the Spectrum's resolution and colour range permits. But putting a detailed colour picture on the screen could be a lengthy process. The programs are written in Basic and some of the routines are rather slow.

For example, keyboard entries are not detected instantly and filling an enclosed area can make demands on your patience. Bursts of



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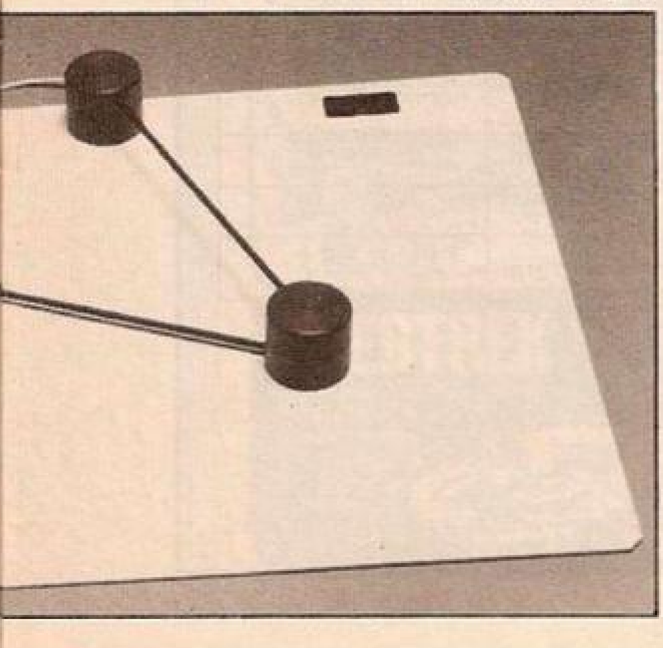
ETS

rapid sketching are too much for the tracer to copy faithfully.

This is a software, not a hardware, problem. To be fair, the routines RD Laboratories supplies are adequate but machine-code versions would make the tracer much more effective.

The software cassette also contains a program which prints the x and y co-ordinates of the tracer at the top of the screen as it moves and allows the origin and scale of the plotting co-ordinates to be changed. The third program provides a blind-drawing facility; points can be inputted at greater speed than normal and are then drawn at a slower speed.

Lastly, there is a program to design characters which does not make use of the tracer and which is given free to the buyer.



While the tracer has an obvious use in schools and could perhaps even find a place in an office, RD Laboratories say that they have taken at least 50 percent of their orders from home users.

At a price of £49.95, inclusive of VAT and postage, this is the first such device to be produced which is suitable for low-cost micros.

It will also work with the ZX-81 and two short programs are included for this purpose but the ZX-81's limited screen resolution gives it only a limited application.

Software support

RD Laboratories intends to support the tracer with more general-purpose and specialised software packages. Details from 5 Kennedy Road, Dane End, Ware, Hertfordshire SG12 0LU. Telephone: 0920-84380.

Micro Management's Graphics Tablet for the BBC Model B comes ready-mounted on a Perspex board measuring 70 by 56 cm. Like the RD Digital Tracer the tablet has two cylindrical hinges at the base and the centre. Both the central hinge and the tracing head rest on the board which is covered with a Cellophane sheet to permit them to slide freely.

This is a rather more substantial piece of equipment than the Spectrum tracer but can be moved around the board with equal steadiness.

The manual warns that on early models of the BBC wavering might occur around the screen cursor point when drawing. The explanation is that the power pack and other components produce interference.

Wavering certainly occurred on one of the BBC Micros used but cleared up completely on a later model. The company suggests that if the problem persists after you have consulted a dealer you might like to buy their "splendid external converter" which should cure it.

While the hardware appears to be well designed the graphics tablet is poorly served by the software that accompanies it. A program is supplied on cassette and provides many of the same drawing options as the Spectrum tracer's software. These include facilities for drawing a straight line, filling a shape, changing the colour of the line, printing text and displaying the x and y co-ordinates of the cursor. In addition there are commands to position and draw the x and y axes, and to calculate the area of a shape in terms of a scale and units which have previously specified.

Setting the limits

Before drawing, the user needs to set the limits of the drawing area by moving the arm to four positions in sequence. Alternatively these initial settings can be loaded from tape. Screen pictures can also be saved to and loaded from tape.

These options, however, are not well presented. The program gives the user no indication of which plotting mode it is in; no prompts appear on the screen when an input is expected and the position of the cursor is marked by one barely visible pixel.

The existing set of commands allow the user to copy a picture to the screen fairly easily. But given the scope of BBC graphics and the speed of BBC Basic one might reasonably expect a more sophisticated package. It would not have been difficult to have included options for changing the background colour or drawing with a dotted line. A circle-drawing facility would also be useful.

The program provided is a rather makeshift piece of software which makes little use of some of the best features of BBC Basic. Micro Management might reply that the program is not intended to be more than a sampler. But if that is the case the tablet begins to look rather expensive. It costs £86 which seems a lot for what is essentially quite a simple device.

Unlike the Spectrum the BBC Model B already has four analogue to digital converters on board and BBC Basic supplies the ADVAL function to read the converted digital input from the Analogue In port.

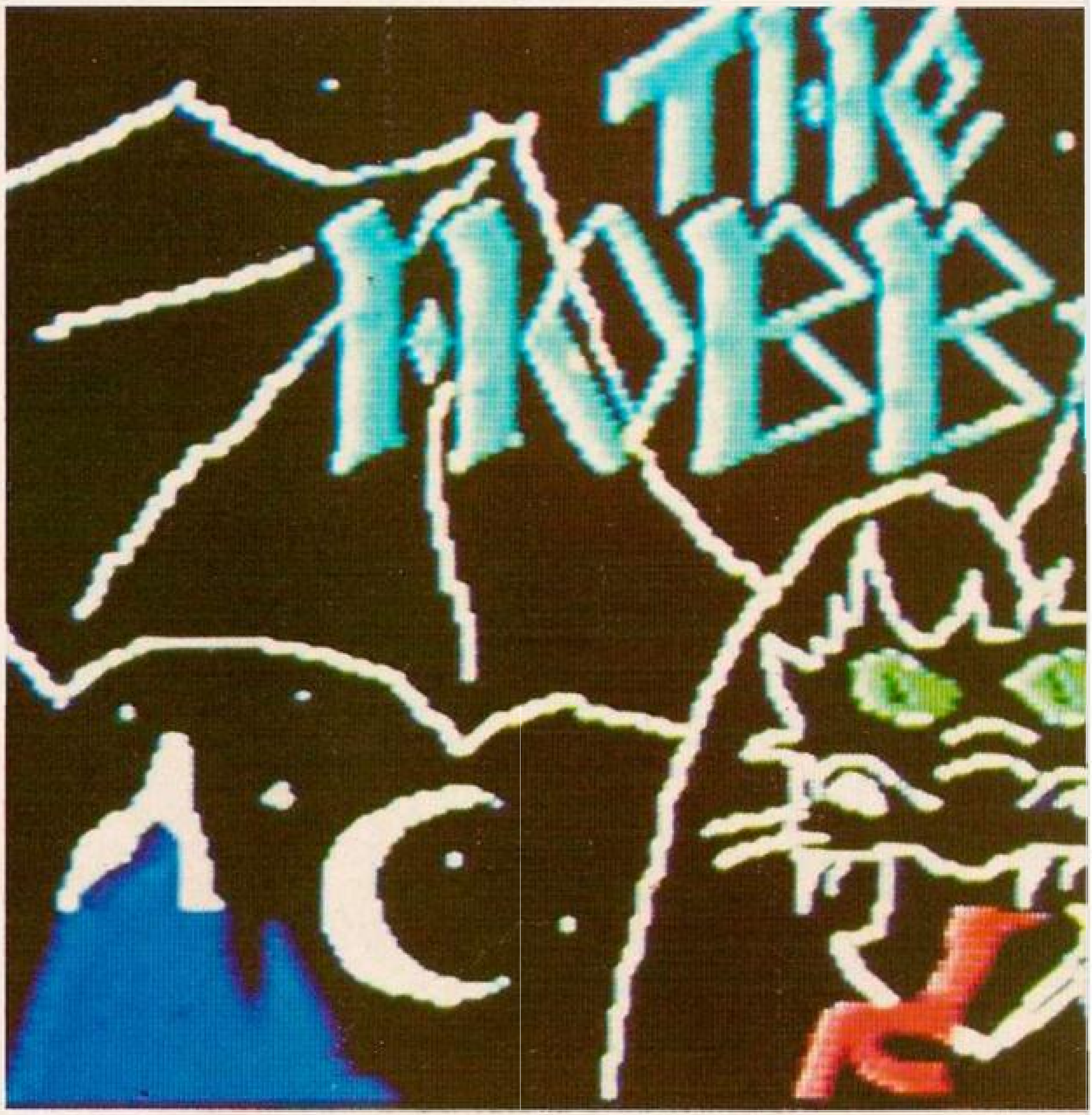
The BBC Graphics Tablet is available from Micro Management, 32 Princes Street, Ipswich, Suffolk. Telephone 0543-59181.

CONCLUSIONS

- Both devices allow a picture to copied to the screen accurately, if rather slowly.
- The Spectrum Tracer's price and light-weight construction make it suitable for the hobbyist and for use in schools.
- Software for the Tracer is adequate but could be greatly improved upon.
- The BBC Graphics Tablet has a more solid design which affords a greater degree of fine control. With appropriate software it could find a wider application, outside the confines of the home and classroom.
- The program supplied with the BBC Tablet is barely satisfactory and scarcely justifies its relatively high cost. ■

SPECTRUM SOFT

Simon Beesley braves attacks by trolls, bombardment by meteoroids, alien invasions and even English literature to bring you up to date with Spectrum software.



THE QUALITY of Spectrum software has improved since our last survey but originality remains in short supply. Most of the programs looked at are games programs and the bulk of these are modelled on the arcade classics, Space Invaders, Pac-Man, Defender and Asteroids. Perhaps this is because the games-buying public is only interested in games that fall into a recognisable category.

Some of the programs are written entirely in Basic. This need not count against them unless the program displays moving graphics.

The Spectrum's keyboard is not very suitable for fast-moving games although Quicksilva and Softek offer a joystick option on some games.

Sinclair has released a large range of programs written for them by ICL and Psion. By and large the ICL programs compare badly with those from Psion and have a rather amateurish look to them.

Each of the tapes in the ICL games series, Games 1 to 4, contains four short Basic programs with titles such as Galactic Invasion, Skittles and Train Race. These are the sort of programs a reader might like to key in from a listing in a magazine. They are fairly simple and afford a limited entertainment for a short period. In view of their variety each package represents reasonable value although they are perhaps more suitable for young people.

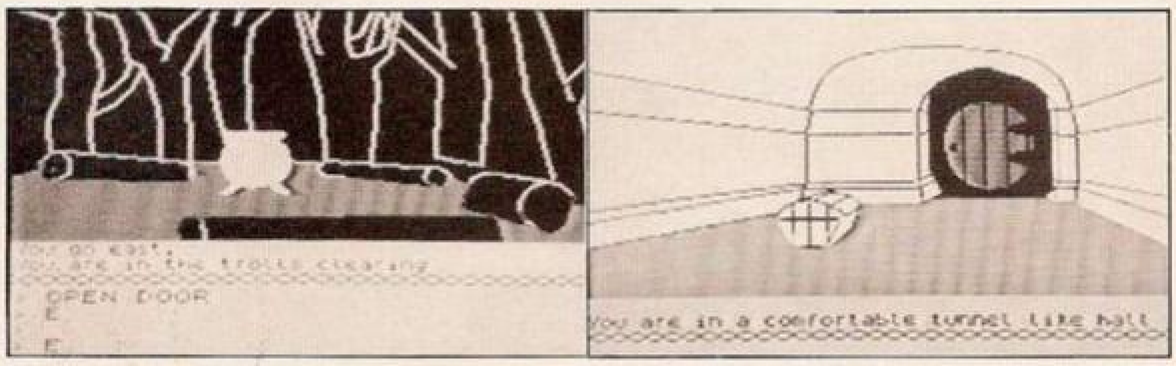
ICL has also produced five titles in a Fun to Learn series covering Music, History, English Literature, Geography and Inventions. They present a variety of quizzes on their respective subjects. Players can compete against each other in a race in which correct answers send them further along the track.

It is difficult to know who these programs are aimed at. One soon runs through the stock of questions and the same names appear in different types of question. Some of the information presented is too obscure or eccentric to make the programs suitable for schools. In the English Literature quiz, for example, Ian Fleming rubs shoulders with Shakespeare and little-known seventeenth century playwrights.

Psion's collection of programs is far more satisfactory. Hungry Horace is loosely related to Pac-Man but has a number of original features. Horace has to eat the flowers in a park while avoiding the park guards. Sinclair gives a fair description of Horace as a subtle and amusing cartoon-style game.

Psion's 48K chess program was written in conjunction with Microgen. It plays a remarkably strong game even at the lower levels. As an averagely competent player I found it quite hard to beat at level two, although its play seemed to come adrift under pressure. The program's response time is quick and the pieces are quite easily distinguished.

Space Raiders and Planetoids are Psion's versions of the arcade games Invaders and Asteroids. Anyone who still has an appetite for these games will find the Psion products more than adequate. With Vu-Calc, Psion has scaled down a Visi Calc-type program to the dimensions of the home micro. These programs, which are commonly used on business micros, are usually described as providing a financial spreadsheet.



Top and above: The Hobbit. Right: Meteoroids, above right, Fun to Learn, and over page Time Gate.

They enable the user to lay out financial data in rows and columns and enter formulae to run calculations on parts or all of the table. Vu-Calc supplies a range of commands for entering data, text or formulae and performing calculations.

Basic programs which have been compiled by Softek's compiler, Super C, run — typically — 10 times faster. The compiler sits at the top of memory above RAMtop and is unaffected by a New command. It leaves room for a Basic program of up to 8K and a further 10K for



WARE

data. The present version cannot cope with decimals, arrays or string variables. These limitations need not be too constricting. Strings, at least, can be stored in the data areas as ASCII codes and accessed through Peeks.

At £14.95 this is good value; particularly since it enables people to write commercially respectable programs without having to master machine code. However Softek insists that anyone planning to sell programs created with the compiler should negotiate for the rights. Softek claims that trace elements have been included to detect code written with Super C.

The arcade game Asteroids crops up on almost every micro. Softek's version Meteoroids is one of the fastest for the Spectrum with good colour and sound. Softime supplies the Spectrum with a digital clock and alarm at the top of the screen which remains there while other programs are loaded and running. The last program in Softek's list is Zolan Adventure, a standard text adventure game which has the merit of fitting into 16K.

Quicksilva gave Time Gate considerable advance publicity claiming it would make as great an impact on the computer games' world as had Atari's Star Raiders. As it turns out the game closely resembles Star Raiders. Given that the Atari is a rather more sophisticated computer it is not surprising that the Spectrum version of the game does not match the original.

Time Gate presents a view from the cockpit of a spaceship. An instrument panel below contains a long-range scanner and a variety of other indicators giving information on the ship's position and damage incurred. Your mission is to clear 18 galactic sectors of enemy craft.

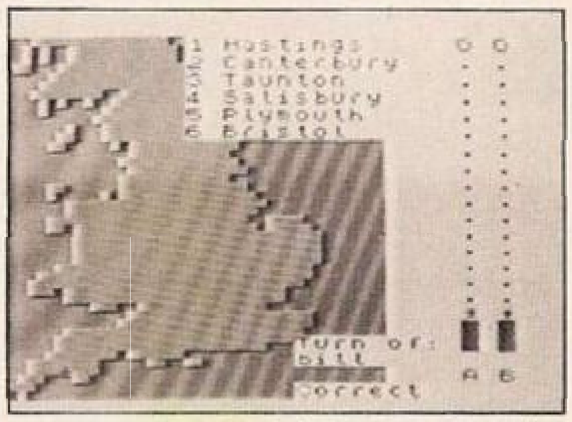
The business of locating and firing on enemy ships is not as interesting as attending to all the other procedures. The controls are not as responsive as on the Atari. Nonetheless this is an elaborate game with excellent graphics — certainly one of the best so far for the Spectrum.

In an impressive piece of synthesised speech Quicksilva's chess program announces itself at the beginning with "this is the Chess Player". Rather startlingly the packaging relates how the Chess Player, an Evil Being, has called for a challenger from Earth. The planet's survival hangs on your game — and you thought you were just going to have a quiet game of chess.

In the event the program plays quite a strong game with the option of six levels of play. The board is clearly displayed and the pieces are well designed. Psion's chess program, however, is probably the better player.

Meteor Storm, another version of Asteroids, also announces itself but rather indistinctly. There is not much to choose between this and Planetoids or Meteoroids. The major problem for software companies writing an Asteroids-

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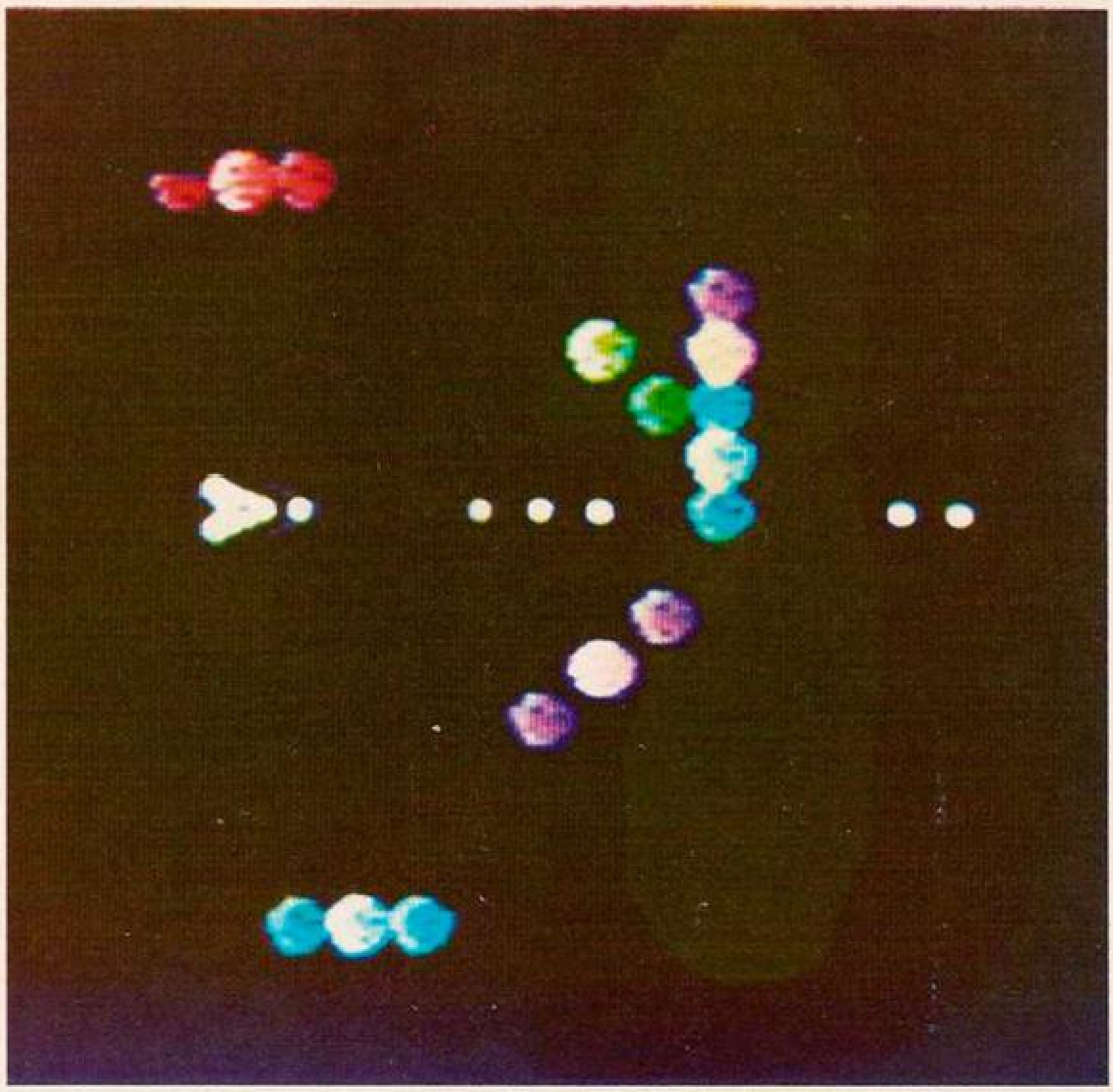


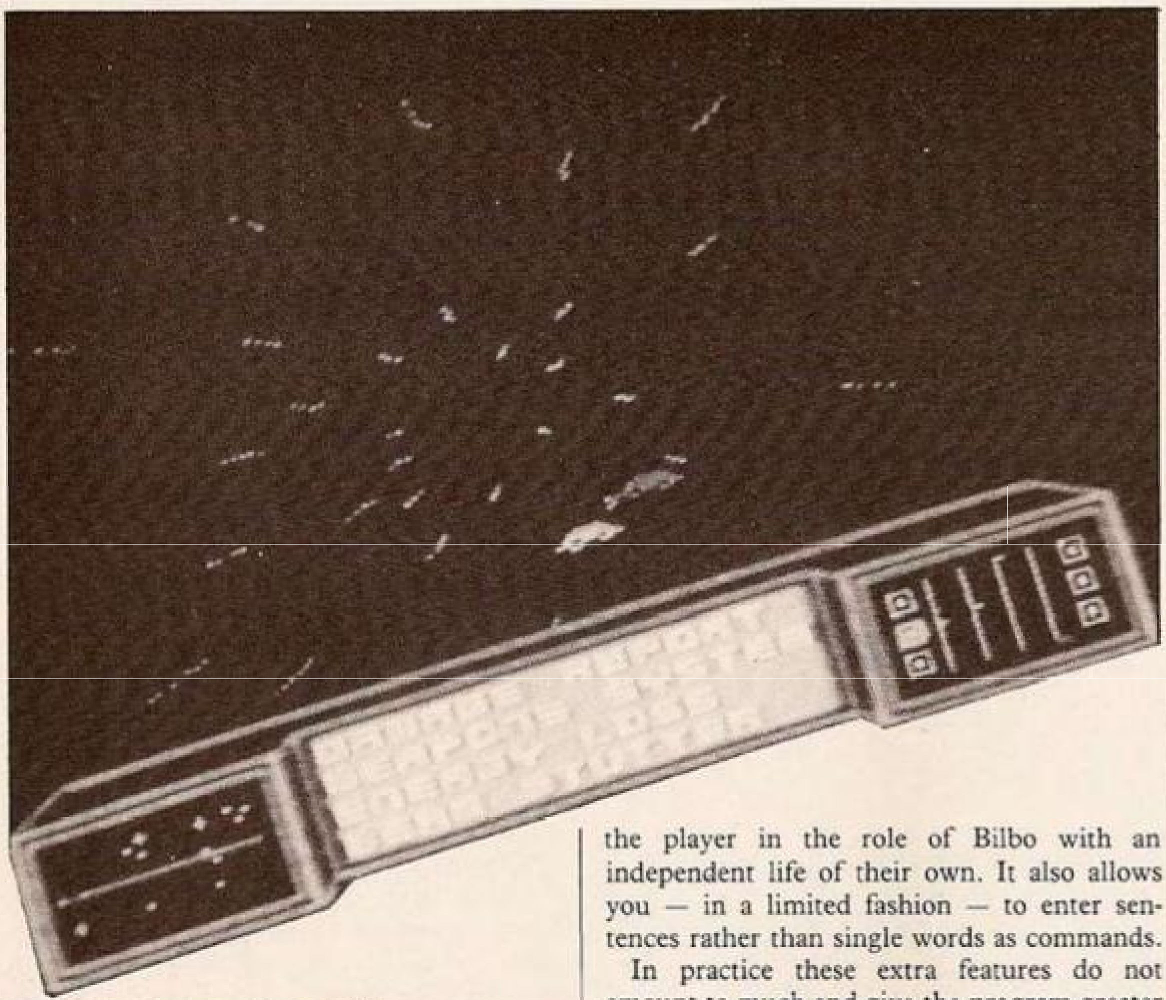
type game must be in finding an alternative title.

Spectres from Bug-Byte gives a novel twist to the Pac-Man concept. Eddie the electrician has to rewire a haunted house. Instead of eating or picking up objects in his path he lays down light bulbs. Reaching one of the four power generators enables him to illuminate the house and drive off ghosts.

The game has a highly individual flavour. The characters which glide around at a fairly leisurely pace, are engagingly different from the standard Pac-Man figures. This is one of the more original games yet to appear for the Spectrum.

Gulpman from Campbell Systems is also based on Pac-Man but refreshingly breaks away from the standard format. It offers a choice of 15 different mazes and allows the speed of play to be set. At the highest levels your little man dashes around the maze at quite a pace. *(continued on next page)*





(continued from previous page)

By contrast Jega's Specman, written in Basic, is dismally slow. Sometimes the ghosts seem to be striken with paralysis and unwilling to take up the chase.

Escape from New Generation Software is a variation on the maze theme which involves escaping from dinosaurs. The dinosaurs — brontosauri, pterodactyls and such like — pursue the player's character with considerable animation through the maze which is shown in bird's-eye view.

Silversoft's games Orbiter and Ground Attack are probably the best Spectrum versions of the arcade games Defender and Scramble. Ground Attack requires the player to fly a plane through a series of caverns and avoid or destroy missile attacks from the ground. Scramble from Work Force is similar but marginally slower. Likewise Avenger — Abacus' version of Defender — is competent but not quite as accomplished as Silversoft's.

Mystery meeting

A gold sundial worth £6,000 is the prize for the first person to solve all the clues in the adventure game Pimania. As in Kit Williams' book *Masquerade*, deciphering all the clues will lead the winner to a meeting at a specific time and place with representatives from the authors of the game, Automata Ltd.

The other side of the program tape contains a disco single. Automata say that the clues are scattered in the music, the program and the graphics. Although we did not proceed very far with the quest the music and opening graphics seemed to bear out Automata's claim that the world of the Pi Man is totally bizarre.

Melbourne House has based The Hobbit, on the novel by Tolkien. It helps to have read the book in finding your way about.

The Hobbit is claimed to be an advance on other adventure games because it introduces other characters from the book who react to the player in the role of Bilbo with an independent life of their own. It also allows you — in a limited fashion — to enter sentences rather than single words as commands.

In practice these extra features do not amount to much and give the program greater scope for the sort of inconsistencies adventure programs are prone to. Thorin, for example, repeatedly enters the scene and tells you to hurry up. This is irritating because you were unaware that he had left and he seems to be totally devoid of constructive ideas. It is not a good idea, however, to kill him off since he sometimes proves too strong for your attack. Furthermore the manual suggests that you should stay on good terms with the other members of your party if you are to succeed in your quest.

Many of the locations in the adventure are illustrated by some excellent graphics. We only managed to complete 7.5 percent of the game during which the text was accompanied by six different pictures. The graphics coupled with a more varied plot than usual make The Hobbit superior to any other adventure games available for the Spectrum.

Both the assemblers tested, from ACS and PI software, require Z-80 mnemonics to be entered in Rem statements and both allow addresses to be replaced by labels. The ACS assembler, Ultraviolet, costs twice as much at £7.50 but offers several extra features. It allows multiple statement lines and provides five pseudo-instructions such as DEFS, which inserts a string of ASCII characters at the current assembly position.

ACS also supplies a disassembler, Infrared. Like the assembler this has two different versions for 16K or 48K machines. The program is easy to use and does all you might expect from it. ■

Company	Program name	Memory required	Price
SN	Games 1-4	16K	£4.95
	Hungry Horace	16K	£5.95
	Fun to Learn	16K	£6.95
	Chess	48K	£7.95
	Vu-Calc	48K	£8.95
	Space Raiders	16K	£4.95
	Planetoids	16K	£4.95
QS	The Chess Player	48K	£6.95
	Time Gate	48K	£6.95
	Meteor Storm	16K	£4.95
SF	Super C	48K	£14.95
	Meteoroids	16K	£4.95
	Softime	16K	£3.95
	Zolan Adventure	16K	£4.95
SS	Orbiter	16K	£5.95
	Ground Attack	16K	£5.95

Company	Program name	Memory required	Price
MH	The Hobbit	48K	£14.95
AU	Pimania	48K	£10
WF	Scramble	16K	£4.95
AB	Avenger	16K	£4.95
CS	Gulpman	16K	£5.95
JS	Specman	16K	£5.95
AC	Ultraviolet	16K	£7.50
	Infrared	16K	£6.75
PI	Assembler	16K	£3.75
NG	Escape	16K	£4.95
BB	Spectres	16K	£8

SN Sinclair Research, Stanhope Road, Camberley, Surrey.

SF Softek, 329 Croxted Road, London SE24.

SS Silversoft, 20 Orange Street, London WC2H 7ED.

MH Melbourne House 131 Trafalgar Road, Greenwich, London SE10.

CS Campbell Systems, 15 Rous Road, Buckhurst Hill, Essex IG9 6BL.

AC ACS Software, 7 Lidgett Crescent, Roundhay, Leeds LS8 1HN.

PI PI Software, 18 Pilgrim's Lane, London NW3 1SN.

AB Abacus Programs, 186 Saint Helens Avenue, Swansea, West Glamorgan SA1 4NE.

QS Quicksilva, 92 Northern Road, Southampton SO2.

AU Automata Ltd, 65a Osborne Road, Portsmouth PO5 3LR.

WF Work Force, 140 Wilsden Avenue, Luton, Bedfordshire.

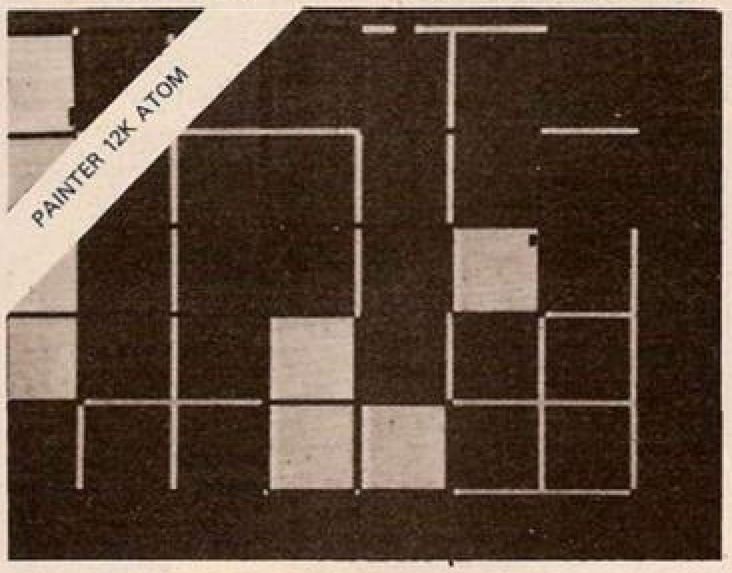
JS Jega Software, 27 Hallcroft Avenue, Countesthorpe, Leicestershire LE8 3SL.

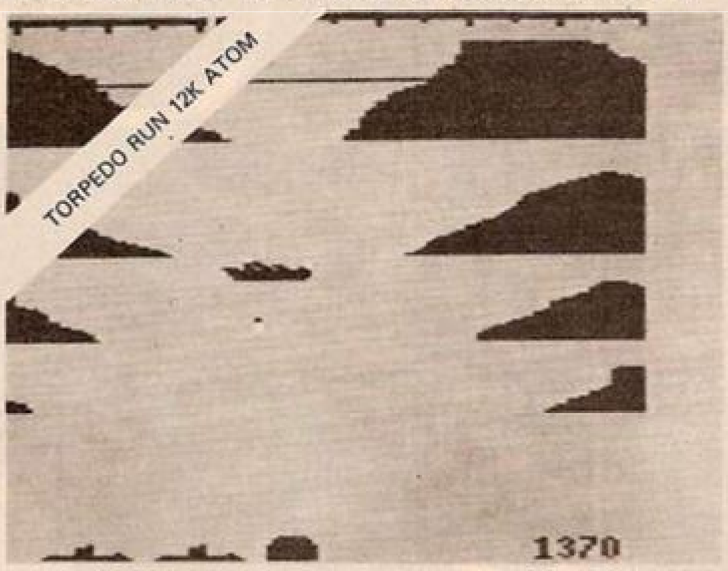
NG New Generation Software, Freepost (BS 3434), Old Land Common, Bristol BS15 6BR.

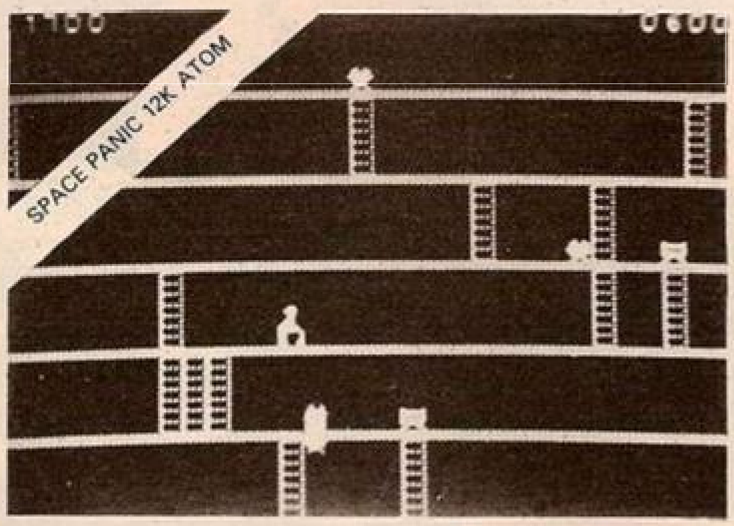
BB Bug-Byte, Freepost, Liverpool L3 3AB.

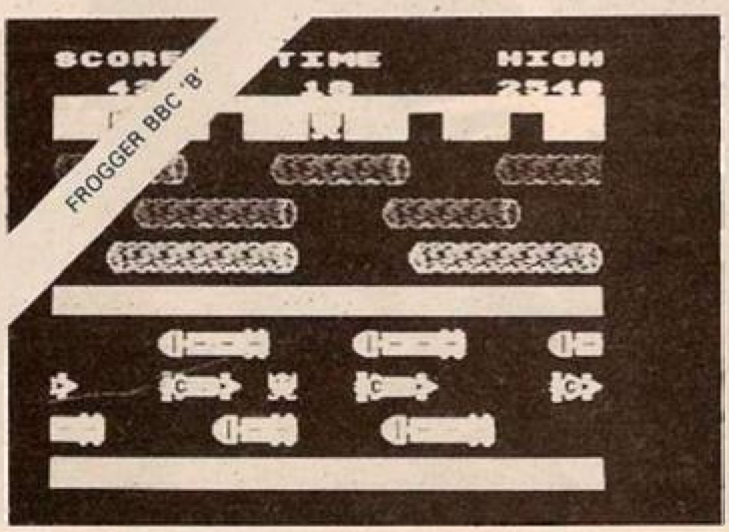
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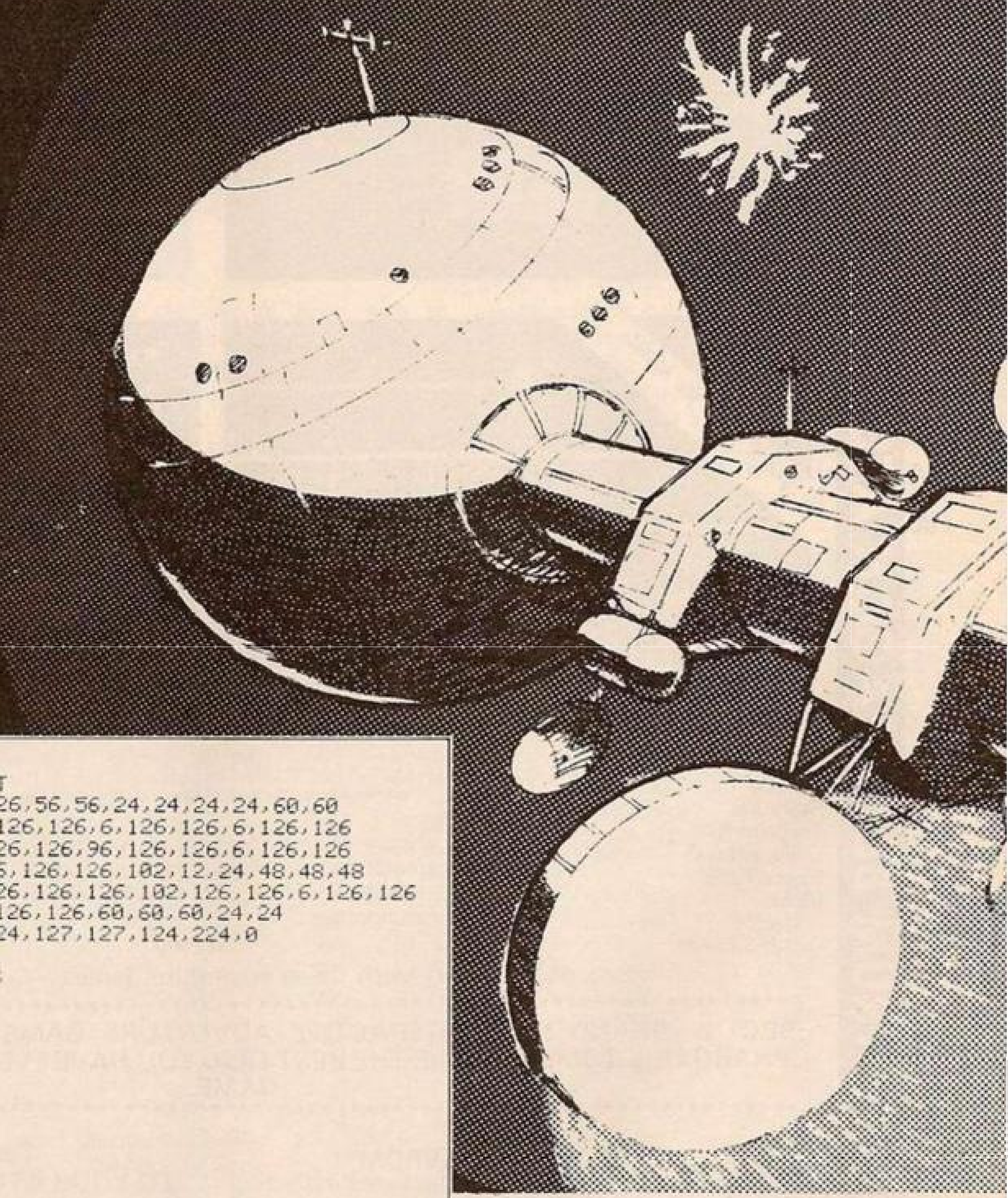
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```
0 FORI=7552TO7671:READA:POKEI,A:NEXT
1 DATA126,126,102,102,102,102,126,126,56,56,24,24,24,24,60,60
2 DATA126,126,6,126,126,96,126,126,126,126,6,126,126,6,126,126
3 DATA96,96,108,108,126,126,12,12,126,126,96,126,126,6,126,126
4 DATA126,126,96,126,126,102,126,126,126,126,102,12,24,48,48,48
5 DATA126,126,102,126,126,102,126,126,126,126,102,126,126,6,126,126
6 DATA24,24,60,60,60,126,126,66,66,126,126,60,60,60,24,24
7 DATA0,7,62,254,254,62,7,0,0,224,124,127,127,124,224,0
8 DATA0,60,126,171,213,126,60,0
10 PRINT"⌐▓▓                ";
11 PRINT"▓ ____________________ ";
12 FORT=1TO20
13 PRINT"▓|                   |";
14 NEXTT
15 PRINT" ────────────────────";
16 POKE36879,8:TI$="000000"
17 POKE36869,255
18 POKE8185,160
19 PRINT"▓▓           ■"TI$"▓    ";
20 GRAPHIC=209:A=7900
21 MINE=160:B=11
22 V=8142
23 Z=5
24 CL=0:POKE36878,15
25 X=8142:SOUND=36876
26 Y=15
27 LC=0
28 C=0
30 KEYS=PEEK(197)
41 IFKEYS=47THENC=1:GRAPHIC=59
42 IFKEYS=39THENC=2:GRAPHIC=58
43 IFKEYS=33THENC=3:GRAPHIC=60
44 IFKEYS=26THENC=4:GRAPHIC=61
45 IFC=1THENA=A+22:POKEA-22+B,160
46 IFC=2THENA=A-22:POKEA+22+B,160
47 IFC=3THENB=B-1:POKEA+B+1,160
48 IFC=4THENB=B+1:POKEA+B-1,160
50 IFA=7702THENC=1:GRAPHIC=59:A=A+22
51 IFA=8164THENC=2:GRAPHIC=58:A=A-22
```

THIS PROGRAM for the unexpanded Vic makes economical use of the user-defined character facility. Fifteen characters are defined in data statements and 10 of these redesign the numbers 0 to 9. It would be easier to read the definitions for numerals from the character set in ROM into RAM — but less pleasing to the eye.

In hot pursuit

The object of the game is to manoeuvre your ship around the screen avoiding two saucers in hot pursuit. Use the keys Z and X to turn left and right, the function keys F1 and F3 for up and down. Watch out for the deep-space mines laid by the pursuing alien hostiles.




```
52 IFB=0THENC=4:GRAPHIC=61:B=B+1
53 IFB=21THENC=3:GRAPHIC=60:B=B-1
54 IFPEEK(A+B)=174THENPOKEA+B,215:GOTO800
55 POKEA+B,GRAPHIC
50 CL=CL+1
65 LC=LC+1
70 IFCL=2THENGOSUB200
71 IFLC=3THENGOSUB500
75 PRINT"■■          ■"TI$"■      ";
76 IFPEEK(A+B)=174THEN800
30 GOTO030
200 KM=INT(2*RND(1))
205 IFKM=0THENMINE=174
210 IFB>YTHENY=Y+1:POKEX+Y-1,MINE:POKESOUND,220
220 IFA>XTHENX=X+22:POKEX-22+Y,160:POKESOUND,225
230 IFA<XTHENX=X-22:POKEX+22+Y,160:POKESOUND,230
240 IFB<YTHENY=Y-1:POKEX+Y+1,160:POKESOUND,235
250 POKEX+Y,62
255 CL=0:POKESOUND,0
260 MINE=160
265 IFX=AANDY=BTHEN800
280 RETURN
500 KM=INT(2*RND(1))
505 IFKM=0THENMINE=174
510 IFB>ZTHENZ=Z+1:POKEV+Z-1,160
520 IFA>VTHENV=V+22:POKEV-22+Z,160
530 IFA<VTHENV=V-22:POKEV+22+Z,160
540 IFB<ZTHENZ=Z-1:POKEV+Z+1,MINE
550 POKEV+Z,62
555 LC=0
560 MINE=160
565 IFV=AANDZ=BTHEN800
580 RETURN
800 POKEV+Z,209:POKEX+Y,209
301 POKEA+B,209
302 PRINT"■■■■■■■■■■■■■■■■■■■GAME   OVER"
303 PRINT"■■■■■■■■■■■■PUSH'F7'"
304 GETA$:IFA$="■"THENRUN
305 POKEA+B,215
306 FORT=1TO10:NEXTT
307 GOTO801
```

One problem with redefining a limited character set is that if the program crashes you will not be able to read the error message to find out at which line an error has occurred.

The solution here is to key in

POKE 36869,240

and then press return. This will send the Vic back to the standard character set in ROM and turn the garbage on the screen into letters. Be careful to key it in correctly since the letters you type will not appear as such on the screen.

In line 16 the border and screen colours are set by Poking the value 8 into 36879. Changing this value will set up other colour combinations. ■

SPECTRUM CROSS

Stuart Nicholls' crocodiles and man-eating spiders soon put a stop to uneventful commuting.

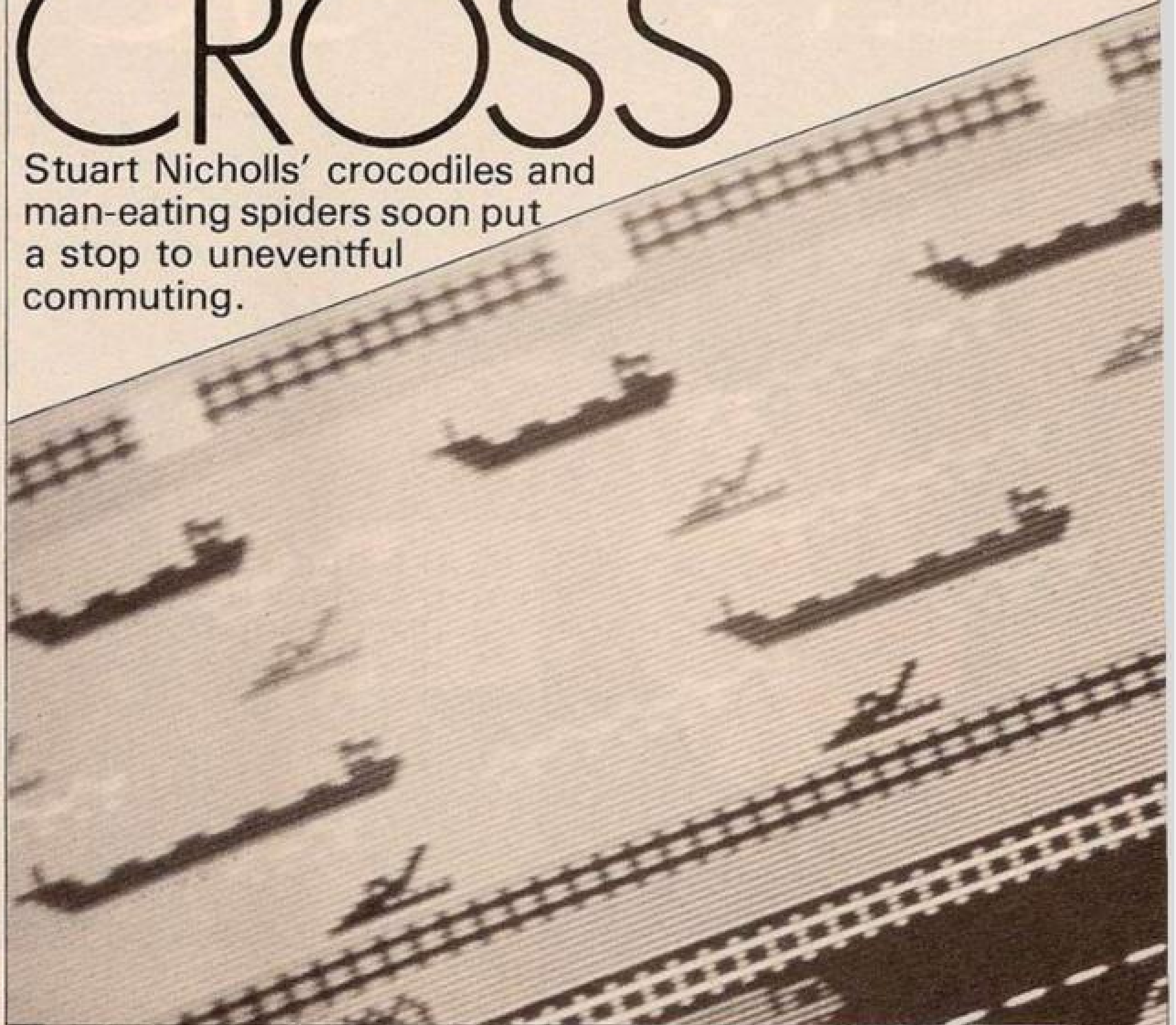
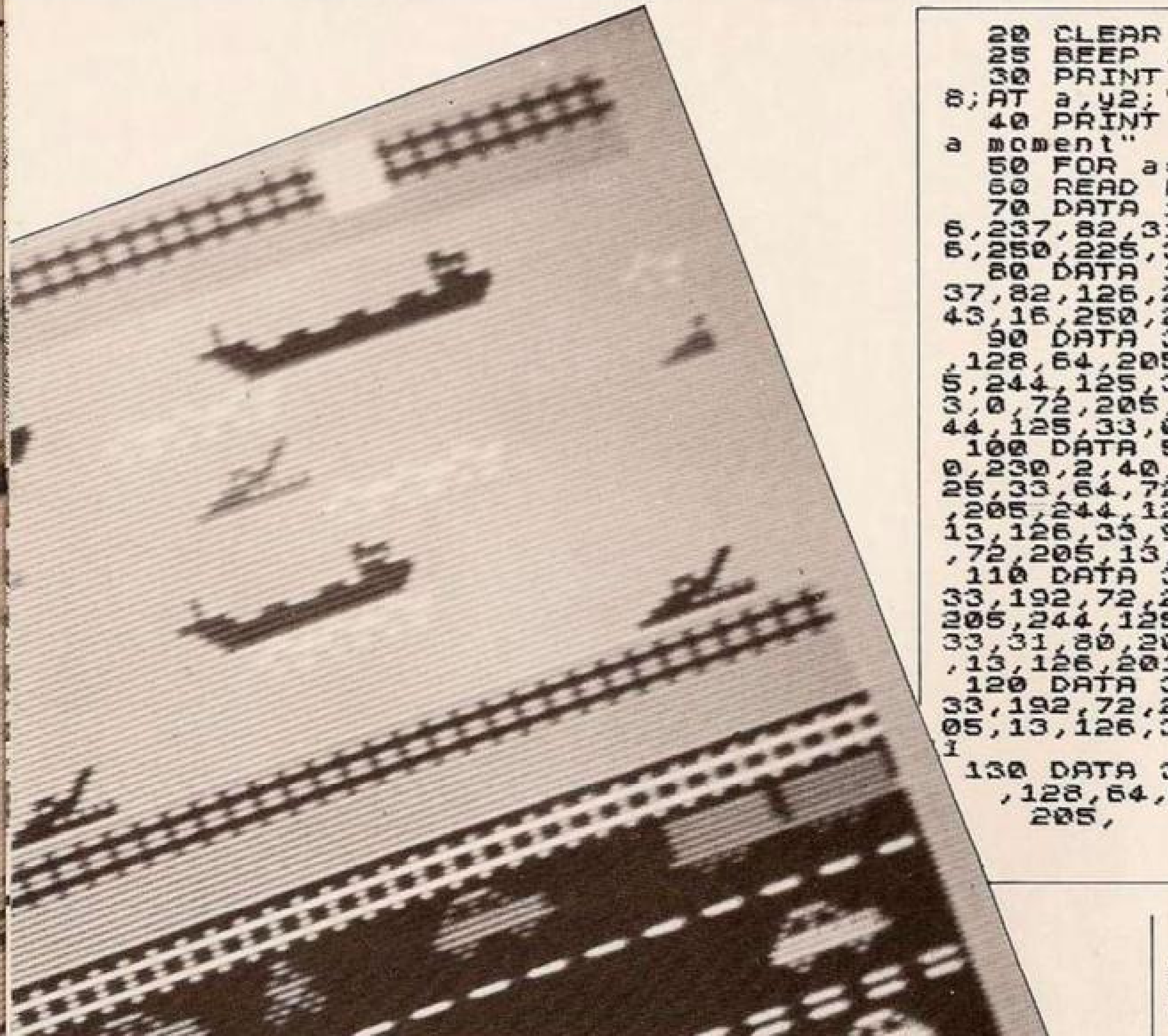


Figure 1.

```
              Code  Address  Mnemonic

              14    32244    LD     C   8
              8     32245
RESTORE
              229   32246    PUSH   HL
              17    32247    LD     DE  31
?             31    32248
              0     32249
              25    32250    ADD    HL  DE
~             126   32251    LD     A   hl
GO SUB        237   32252    ed
R             82    32253
?             31    32254    RRA
              6     32255    LD     B   32
              32    32256
~             126   32257    LD     A   hl
?             31    32258    RRA
w             119   32259    LD     hl  A
#             35    32260    INC    HL
              16    32261    DJNZ       -6
IF            250   32262
LLIST         225   32263    POP    HL
$             36    32264    INC    H
              13    32265    DEC    C
              32    32266    JR     NZ  -22
REM           234   32267
<>            201   32268    RET
              14    32269    LD     C   8
              8     32270
CODE          175   32271    XOR    A
RESTORE       229   32272    PUSH   HL
              17    32273    LD     DE  31
?             31    32274
              0     32275
GO SUB        237   32276    ed
R             82    32277
~             126   32278    LD     A   hl
              25    32279    ADD    HL  DE
              23    32280    RLA
              6     32281    LD     B   32
              32    32282
~             126   32283    LD     A   hl
              23    32284    RLA
w             119   32285    LD     hl  A
+             43    32286    DEC    HL
              16    32287    DJNZ       -6
IF            250   32288
LLIST         225   32289    POP    HL
$             36    32290    INC    H
              13    32291    DEC    C
              32    32292    JR     NZ  -23
DIM           233   32293
<>            201   32294    RET
!             33    32295    LD     HL  16479
              95    32296
@             64    32297
STEP          205   32298    CALL       32269
              13    32299
~             126   32300
!             33    32301    LD     HL  16512
              128   32302
@             64    32303
STEP          205   32304    CALL       32244
POKE          244   32305
}             125   32306
!             33    32307    LD     HL  16512
              128   32308
@             64    32309
STEP          205   32310    CALL       32244
POKE          244   32311
}             125   32312
!             33    32313    LD     HL  16607
OUT           223   32314
@             64    32315
STEP          205   32316    CALL       32269
              13    32317
~             126   32318
!             33    32319    LD     HL  18432
              0     32320
H             72    32321
STEP          205   32322    CALL       32244
POKE          244   32323
}             125   32324
!             33    32325    LD     HL  18432
              0     32326
H             72    32327
STEP          205   32328    CALL       32244
POKE          244   32329
}             125   32330
!             33    32331    LD     HL  18432
              0     32332
H             72    32333
STEP          205   32334    CALL       32244
POKE          244   32335
}             125   32336
;             58    32337    LD     A   (23673
y             121   32338
\             92    32339
              0     32340    NOP
              0     32341    NOP
              0     32342    NOP
              0     32343    NOP
              0     32344    NOP
              0     32345    NOP
              0     32346    NOP
NEW           230   32347    AND    2
              2     32348
(             40    32349    JR     Z   20
              20    32350
!             33    32351    LD     HL  18496
@             64    32352
H             72    32353
STEP          205   32354    CALL       32244
POKE          244   32355
}             125   32356
!             33    32357    LD     HL  18496
@             64    32358
H             72    32359
STEP          205   32360    CALL       32244
POKE          244   32361
}             125   32362
!             33    32363    LD     HL  18496
@             64    32364
H             72    32365
STEP          205   32366    CALL       32244
POKE          244   32367
}             125   32368
              24    32369    JR         18
              18    32370
!             33    32371    LD     HL  18527
              95    32372
H             72    32373
STEP          205   32374    CALL       32269
              13    32375
~             126   32376
!             33    32377    LD     HL  18527
_             95    32378
H             72    32379
STEP          205   32380    CALL       32269
              13    32381
~             126   32382
!             33    32383    LD     HL  18527
              95    32384
H             72    32385
STEP          205   32386    CALL       32269
              13    32387
~             126   32388
!             33    32389    LD     HL  18560
              128   32390
H             72    32391
STEP          205   32392    CALL       32244
POKE          244   32393
}             125   32394
!             33    32395    LD     HL  18624
USR           192   32396
H             72    32397
STEP          205   32398    CALL       32244
POKE          244   32399
}             125   32400
!             33    32401    LD     HL  18624
USR           192   32402
H             72    32403
STEP          205   32404    CALL       32244
POKE          244   32405
}             125   32406
!             33    32407    LD     HL  20511
?             31    32408
P             80    32409
STEP          205   32410    CALL       32269
              13    32411
~             126   32412
!             33    32413    LD     HL  20511
?             31    32414
P             80    32415
STEP          205   32416    CALL       32269
              13    32417
~             126   32418
!             33    32419    LD     HL  20575
              95    32420
P             80    32421
STEP          205   32422    CALL       32269
              13    32423
~             126   32424
              0     32425    NOP
!             33    32426    LD     HL  18560
              128   32427
H             72    32428
STEP          205   32429    CALL       32244
POKE          244   32430
}             125   32431
!             33    32432    LD     HL  18624
USR           192   32433
H             72    32434
STEP          205   32435    CALL       32244
POKE          244   32436
}             125   32437
!             33    32438    LD     HL  20511
?             31    32439
P             80    32440
STEP          205   32441    CALL       32269
              13    32442
~             126   32443
!             33    32444    LD     HL  20575
              95    32445
P             80    32446
STEP          205   32447    CALL       32269
              13    32448
~             126   32449
<>            201   32450    RET
!             33    32451    LD     HL  16479
              95    32452
@             64    32453
STEP          205   32454    CALL       32269
              13    32455
~             126   32456
!             33    32457    LD     HL  16512
              128   32458
@             64    32459
STEP          205   32460    CALL       32244
POKE          244   32461
}             125   32462
!             33    32463    LD     HL  18432
              0     32464
H             72    32465
STEP          205   32466    CALL       32244
POKE          244   32467
}             125   32468
<>            201   32469    RET
!             33    32470    LD     HL  16479
              95    32471
@             64    32472
STEP          205   32473    CALL       32269
              13    32474
~             126   32475
!             33    32476    LD     HL  16607
OUT           223   32477
@             64    32478
STEP          205   32479    CALL       32269
              13    32480
~             126   32481
!             33    32482    LD     HL  18560
              128   32483
H             72    32484
STEP          205   32485    CALL       32244
POKE          244   32486
}             125   32487
!             33    32488    LD     HL  18624
USR           192   32489
H             72    32490
STEP          205   32491    CALL       32244
POKE          244   32492
}             125   32493
<>            201   32494    RET
```




```
   20 CLEAR 32243: GO TO 40
   25 BEEP .01,b-a
   30 PRINT OVER 1; PAPER 8; INK
8;AT a,y2;"X": RETURN
   40 PRINT AT 11,5;"Please wait
a moment"
   50 FOR a=32244 TO 32494
   60 READ b: POKE a,b: NEXT a
   70 DATA 14,8,229,17,31,0,25,12
6,237,82,31,6,32,126,31,119,35,1
6,250,225,36,13,32,234,201
   80 DATA 14,8,175,229,17,31,0,2
37,82,126,25,23,6,32,126,23,119,
43,16,250,225,36,13,32,233,201
   90 DATA 33,95,64,205,13,126,33
,128,64,205,244,125,33,128,64,20
5,244,125,33,223,64,205,13,126,3
3,0,72,205,244,125,33,0,72,205,2
44,125,33,0,72,205,244,125
  100 DATA 58,121,92,0,0,0,0,0,0,
0,230,2,40,20,33,64,72,205,244,1
25,33,64,72,205,244,125,33,64,72
,205,244,125,24,18,33,95,72,205,
13,126,33,95,72,205,13,126,33,95
,72,205,13,126
  110 DATA 33,128,72,205,244,125,
33,192,72,205,244,125,33,192,72,
205,244,125,33,31,80,205,13,126,
33,31,80,205,13,126,33,95,80,205
,13,126,201
  120 DATA 33,128,72,205,244,125,
33,192,72,205,244,125,33,31,80,2
05,13,126,33,95,80,205,13,126,20
1
  130 DATA 33,95,64,205,13,126,33
   ,128,64,205,244,125,33,0,72,
    205,
```

(continued on next page)

THIS GAMES program — written in machine code and Basic — just fills a 16K Spectrum. It makes full use of all the colours available and all 21 user-definable graphics.

The object of the game is to cross a busy road and river to arrive safely home. The graphics are flicker-free and move smoothly. The graphics character for the man, however, flashes to indicate position.

The machine-code section of the program is used to roll a screen line left or right — one pixel at a time — to give the illusion of a smooth flow of traffic. The machine code and mnemonics that achieve this are shown in figure 1. This machine code is entered above RAMtop and is held in Data lines 70 to 140.

The second set of Data — that is, lines 180 to 270 — is for the user-defined graphics. It is the easiest way to set them up. First, the start address of the user-defined graphics is found by Peeking the system variable 23675/6, so it is equally suitable for the 16K and 48K Spectrum, and then all 168 bytes are entered, starting from this address, in one For-Next loop. It does seem rather long-winded to have 21 For-Next loops as suggested in the Spectrum manual, when the addresses of the user-defined graphics run consecutively.

Once the program has been entered it is advisable to Save it before Running just in case a wrong machine-code Data entry has been made which may cause the program to crash.

Your man moves at a speed of eight pixels per second and so can outrun all the traffic, but be careful not to hit traffic from behind. Use 0 to move right, 9 to move left, and 1 to move up.

A fanfare is played each time a home is filled and 50 bonus points are given. Every time four homes are filled an extra fanfare is played, the homes empty, the speed increases — there are three changes of speed — an extra random position spider is added, and the game continues. The spiders incidentally move in both directions. A maximum of 10 spiders can be placed on the central island, but I have not managed that level myself yet.

Each time your man is hit he will flash for a few seconds to the sound of a rising beep and then fall back down the screen to the base line to the sound of a falling beep. The men-counter will be reduced by one. The subroutine for this flash and beep — lines 25 and 30 — has been placed at the start of the listing so that access time is reduced to a minimum. The Spectrum searches through the listing from the beginning each time a subroutine is called and so, if placed at the end of the program, it would take longer to locate and slow down the rate of flash and beep.

At the end of the game, when all men are lost, you are given the option to replay or end. If the N key is pressed then RAMtop will be reset to its normal value on both 16K and 48K Spectrums and the program including user-defined graphics will be erased from memory. This is achieved in just one instruction

RANDOMISE USR 0

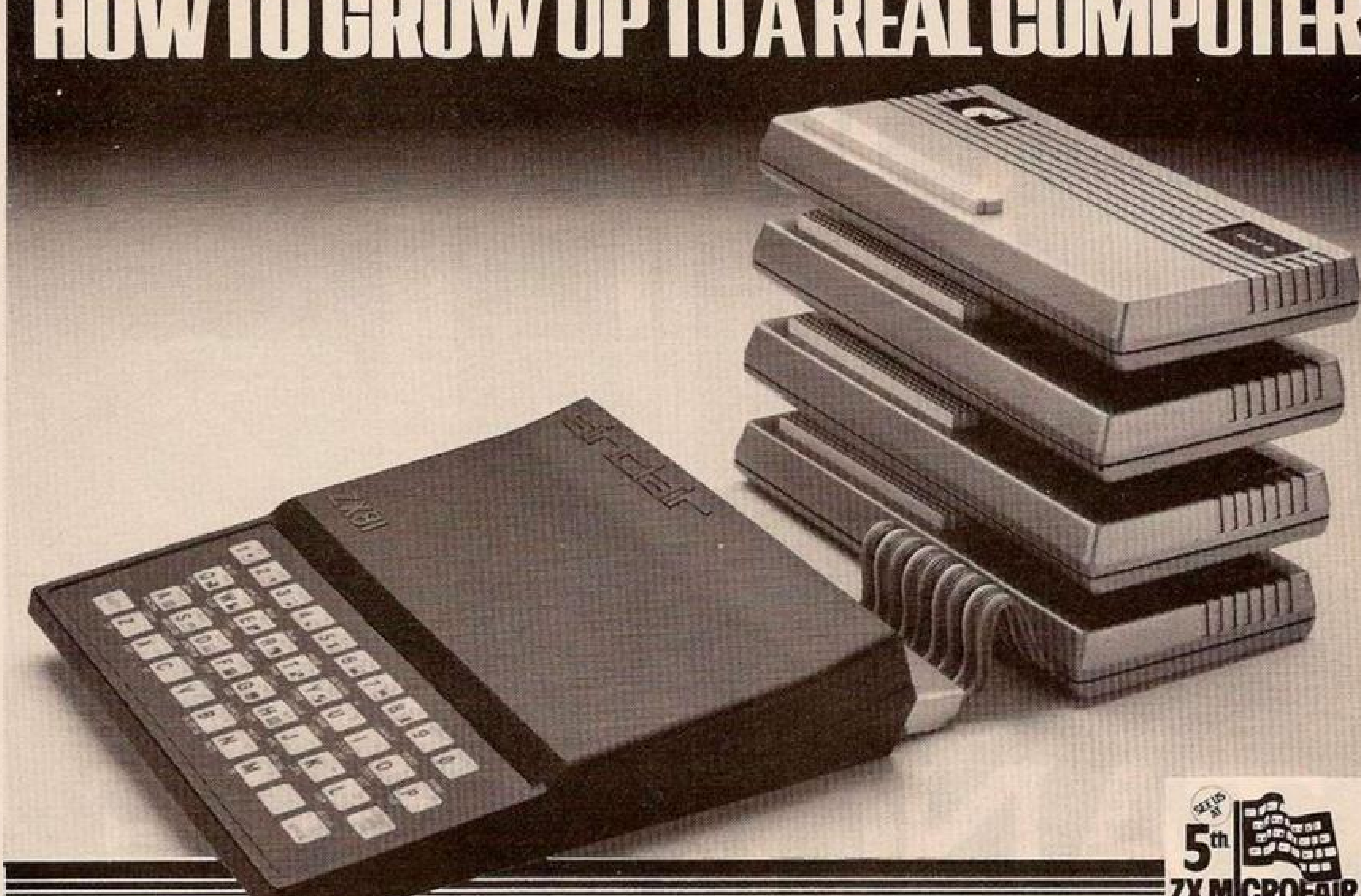
One last useful feature of the Spectrum is used to detect a hit. This is shown in line 690 when Screen$ will return a string containing a space if there is no traffic in the next "Print man" position or an empty string if the next Print position is a user-defined graphic or part of a user-defined graphic.

(continued from previous page)

```
244,125,201
 140 DATA 33,95,64,205,13,126,33
,223,64,205,13,126,33,128,72,205
,244,125,33,192,72,205,244,125,2
01
 150 LET a=PEEK 23675+256*PEEK 2
3676
 160 FOR b=a TO a+167
 170 READ c: POKE b,c: NEXT b
 180 DATA 15,18,34,127,255,255,4
0,16,128,64,32,254,254,255,40,16
 190 DATA 127,127,127,127,127,25
5,21,8,254,254,254,254,255,255,6
4,128
 200 DATA 0,248,196,196,254,254,
40,16,24,24,36,126,60,90,165,66
 210 DATA 56,40,146,124,56,56,40
,108,1,2,4,127,127,255,20,8
 220 DATA 240,72,68,254,255,255,
20,8,0,31,35,35,127,127,20,8
 230 DATA 127,127,127,127,255,25
5,2,1,254,254,254,254,254,255,16
8,16
 240 DATA 16,41,199,0,38,0,0,0,0
,66,255,66,66,255,66,0
 250 DATA 0,34,85,143,151,163,16
0,0,0,68,170,241,233,197,5,0
 260 DATA 16,16,16,254,63,31,15,
7,0,0,0,0,30,255,255,255
 270 DATA 96,124,84,120,127,255,
254,252,0,0,3,2,15,63,255,0,6,12
,152,240,224,85,255,0
 280 PRINT AT 11,3;"Do you want
instructions?";AT 13,11;"(y)es";
AT 15,11;"(n)o"
 290 PAUSE 0: IF INKEY$="y" THEN
 GO TO 300
 295 GO TO 400
 300 CLS : PRINT AT 0,11;"OBJECT
"'''"To guide a   across a road a
nd ariver,avoiding
 ."'''"A    patrols the central
 island."
 310 PRINT ''"There are 4 HOMES
to be filled. i.e. gaps in top f
ence ##### #####"
 320 PRINT '"Once all 4 HOMES ar
e filled the speed will increase
,an extra    will be added and t
he HOMES willempty."
 330 PRINT '''AT 18,9;"Press any
 key.": PAUSE 0
 370 CLS : PRINT AT 7,11;"CONTRO
LS"
 375 PRINT '"               ↑
  <  >"
 380 PRINT FLASH 1;AT 11,6;"1";
FLASH 0;" 2 3 4 5 6 7 8 "; FLASH
 1;"9"; FLASH 0;" "; FLASH 1;"0"
 390 PRINT AT 18,5;"Press any ke
y to PLAY": PAUSE 0
 400 BRIGHT 1: PAPER 5: BORDER 5
: CLS
 410 LET hi=0
 420 PRINT PAPER 4;AT 10,0;"
     "
 430 LET lives=9: LET score=0: L
ET home=0
 440 POKE 32425,201: POKE 32450,
201: POKE 32469,201
 450 PRINT AT 0,0; PAPER 4;"#####
"; PAPER 7;" "; PAPER 4;"########"
; PAPER 7;" "; PAPER 4;"########"
; PAPER 7;" "; PAPER 4;"########"
; PAPER 7;" "; PAPER 4;"#####"
 455 IF home<>0 THEN GO TO 660
 460 PRINT PAPER 4; INK 5;"
 470 PRINT "
 480 PRINT INK 7;"
 490 PRINT INK 2;"
 500 PRINT INK 7;"
 510 PRINT INK 1;"
 520 PRINT INK 7;"
 530 PRINT "
 540 PRINT PAPER 4;"##############
###########################"
 550 PRINT PAPER 0; INK 7;AT 11,
0;"######################################
#####"
 560 PRINT PAPER 0; INK 3;"
 570 PRINT PAPER 0; INK 7;"-----
---------------------------"
 580 PRINT PAPER 0; INK 5;"
 590 PRINT PAPER 0; INK 7;"=====
==========================="
 600 PRINT PAPER 0; INK 4;"
 610 PRINT PAPER 0; INK 7;"-----
---------------------------"
 620 PRINT PAPER 0; INK 6;"
 630 PRINT PAPER 4;"##################
###########################"
 640 PRINT PAPER 4;"
 650 PRINT PAPER 1; INK 7;" SCOR
E ";AT 21,11;" MEN "; PAPER 5; I
NK 0;lives; PAPER 1; INK 7;" HI-
SCORE "
 660 LET x1=20: LET y1=16: LET x
2=x1: LET y2=y1
 670 PRINT PAPER 8; INK 8;AT x1,
y1;" "
 680 RANDOMIZE USR 32295
 690 IF SCREEN$ (x2,y2)=" " THEN
 GO TO 880
 700 LET a=x2: FOR b=25 TO 35: G
O SUB 25: GO SUB 25: NEXT b
 730 FOR a=x2 TO 20 STEP 2: GO S
UB 25: GO SUB 25: NEXT a
 740 LET lives=lives-1: PRINT AT
 21,16;lives
 750 LET x2=20
 760 IF lives<>0 THEN GO TO 680
 770 IF hi>score THEN GO TO 790
 780 LET hi=score: PRINT AT 21,2
7;hi
 790 PRINT FLASH 1; PAPER 7;AT 1
2,0;"          GAME  OVER
   "
 800 PRINT AT 14,0;" Another ga
me ? (y)es  (n)o  "
 840 IF INKEY$="n" THEN RANDOMIZ
E USR 0
 850 IF INKEY$<>"y" THEN GO TO 8
40
 860 PRINT PAPER 5;AT 21,7;"
": GO TO 415
 880 IF x2<>0 THEN GO TO 1050
 890 PRINT PAPER 8; INK 8;AT x1,
y1;" ": PRINT AT x2,y2;" "
 900 RESTORE 920
 910 FOR a=1 TO 8: READ b,c: BEE
P b,c: NEXT a
 920 DATA .1,11,.1,11,.8,16,.05,
11,.05,16,.05,11,.05,16,1,20
 930 LET home=home+1: LET score=
score+50: PRINT AT 21,7;score
 950 IF home/4<>INT (home/4) THE
N GO TO 660
 960 IF home=4 THEN POKE 32425,0
 970 IF home=8 THEN POKE 32450,0
 980 IF home=12 THEN POKE 32469,
0
 985 IF home>36 THEN GO TO 450
 990 LET a=RND*31
1000 LET a=a+1
1005 IF a>31 THEN LET a=0
1010 IF SCREEN$ (10,a)="" THEN G
O TO 1000
1020 IF SCREEN$ (10,a+1)="" THEN
 GO TO 1000
1030 PRINT PAPER 4;AT 10,a;" "
1035 RESTORE 920: FOR a=1 TO 8:
READ b,c: BEEP b,c: NEXT a
1040 GO TO 450
1050 PRINT PAPER 8; INK 8;AT x2,
y2;" "
1060 LET x1=x2: LET y1=y2
1070 IF INKEY$<>"1" THEN GO TO 1
100
1080 BEEP .001,33
1090 LET x2=x2-2: LET score=scor
e+5: PRINT AT 21,7;score
1100 LET y2=y2+(INKEY$="0" AND y
2<>31)-(INKEY$="9" AND y2<>0)
1110 GO TO 670
```

```
AB  =      HI  =      OP  =
CDE =      JKL =      QRS =
F   =      M   =
G   =      N   = #    TU  =
```

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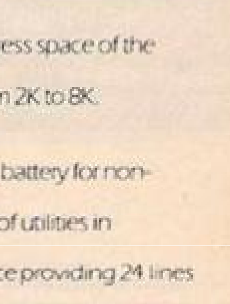
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BASICARE MICRO SYSTEM

Here is the rest of the program required to put a spring in the step of Stuart Nicholls' Happy Hopper. Good luck with your ZX games.

HOPPER

FROGGER (moving graphics)

Address	Code	Instruction	Comment
16775	0E 00	LD C, 00	Roll left/right subroutine.
	7E	LD A, (HL)	A check is make at start of each
	FE 97	CP 97	line to see if the frog will roll off the
	28 1F	JRZ +31	screen. If it does, then a jump is made
	F5	PUSH AF	to miss out the roll sequence.
	06 13	LD B, 13	
	23	INC HL	The background character occupied by the
	7E	LD A, (HL)	frog is then found and used to erase
	2B	DEC HL	the frog. Also C is increased to 1 so
	77	LD(HL), A	that a check can be make that the
	23	INC HL	subroutine has been skipped.
	10 F9	DJNZ -7	
	F1	POP AF	
	77	LD(HL), A	
	19	ADD HL, DE	
	7E	LD A, (HL)	
	FE 97	CP 97	
	28 0D	JRZ + 13	
	F5	PUSH AF	
	06 13	LD B, 13	
	2B	DEC HL	
	7E	LD A, (HL)	
	23	INC HL	
	77	LD(HL),A	
	2B	DEC HL	
	10 F9	DJNZ -7	
	F1	POP AF	
	18 04	JR +4	
	0C	INC C	Increase value of C to 1
	3A 3C 40	LD A, (16444)	Get occupied square character and
	77	LD(HL),A	print over frog.
	C9	RET	Return from subroutine.
			Start of moving graphics routine
16819	2A 0C 40	LD HL(D-FILE)	Get start of D-File.
	23	INC HL	
	11 15 00	LD DE 00 15	LD DE with 21 — DE is not altered from this
	19	ADD HL, DE	value during program, and move to row 2
	CD 87 41	CALL SUB 16775	Roll this row left and next row right.
	0D	DEC C	Check to see if C = 1
	28 BO	JRZ (To 16753)	if yes, goto 16753
	19	ADD HL, DE	Move down one line.
	CD 87 41	CALL SUB 16775	Roll row left and next row right.
	0D	DEC C	Check to see if C = 1,
	28 A9	JRZ (To 16753)	if yes, goto 16753.
16840	2A 0C 40	LD HL (D-File)	Move along display until frog is
	7E	LD A, (HL)	found. When found erase it with
	FE 97	CP 97	character stored at 16444. Then
	28 03	JRZ +3	store D-file position of frog at
	23	INC HL	16445/6. Remove the frog from
	18 F8	JR -8	the display before rolling the road
	3A 3C 40	LD A (16444)	otherwise the frog will move with the
	77	LD(HL),A	traffic.
16858	2A 0C 40	LD HL (D-File)	Get start of road 6 lines down.
	23	INC HL	
	06 06	LD B, 06	
	19	ADD HL, DE	
	10 FD	DJNZ -3	
	CD 87 41	CALL 16701	Call roll left/right
	19	ADD HL, DE	Move to next line
	CD 87 41	CALL 16701	Call roll left/right. There is no need for a check that C = 1 as frog has been removed from display.
16874	2A 3D 40	LD HL,(16445/6)	Load HL with frog position.
	3A 26 40	LD A,(16422)	Load A with "last key high"
	FE DF	CP DF	Value if key is "5"
	20 03	JRNZ +3	
	2B	DEC HL	If 5 then decrease HL
	18 22	JR (16921)	
	FE F7	CP F7	Value if key is 8
	20 03	JRNZ +3	
	23	INC HL	If 8 then increase HL
	18 1B	JR (16921)	
	FE FD	CP FD	Value if key is 0
	20 17	JRNZ (16921)	
	ED 52	SBC HL, DE	If 0 then move 1 line.
	E5	PUSH HL	Store new position of frog.
16901	2A 0C 40	LD HL(D-File)	Increase score routine. Used only
	01 ED 00	LD BC 00 ED	when frog moves up.
	09	ADD HL, BC	
	7E	LD A,(HL)	
	3C	INC A	
	FE A6	CP A6	
	20 05	JRNZ +5	
	36 9C	LD(HL), 9C	
	2B	DEC HL	
	18 F5	JR -11	
	77	LD(HL), A	
16920	E1	POP HL	Get store new frog position
	7E	LD A(HL)	Check that it is not off screen.
	FE 76	CP 76	
	20 04	JRNZ +4	If not, then check new position
	2A 3D 40	LD HL(156446/6)	If it is off screen then get original
	7E	LD A,(HL)	position and check it.
	FE 17	CP 17	Check if home
	20 10	JRNZ +16	
	36 AD	LD(HL), AD	If home then print H.
16936	2A 0C 40	LD HL(D-File)	Check top row to see if all home
	23	INC HL	bases are filled, if yes then return
	7E	LD A(HL)	to Basic. If * is found, then
	FE 76	CP 76	jump to dual-purpose delay at 16966.
	C8	RETZ	
	FE 17	CP 17	
	20 F7	JRNZ -7	
	18 10	JR +16	
16950	FE 80	CP 80	Check new frog position for safe
	28 IC	JRZ (16982)	squares that is road logs lily or
	FE 83	CP 83	kerbs, and if any of these then
	28 18	JRZ (16982)	proceed to 16982.
	FE 1C	CP 1C	
	28 14	JRZ (16982)	
	FE 08	CP 08	
	28 10	JRZ (16982)	
			Dead frog/home delay
16966	F5	PUSH AF	
	36 17	LD(HL), 17	Print an * in place frog/ found unfilled home position
	11 00 10	LD DE, 10 00	Delay loop
	1B	DEC DE	
	7A	LD A, D	
	BC	OR E	
	Z+* FB	JRNZ -5	
	F1	POP AF	Get original square character.
	77	LD(HL) A	Print it.
	C3 71 41	JP (16753)	Start again with frog at baseline
16982	32 3C 40	LD(16444),A	Store new square value before
	36 97	LD(HL) 97	overprinting frog.
16987	2A 0C 49	LD HL (D-File)	Decrease time routine as in
	01 F7 00	LD BC, 00 F7	demonstration program except that
	09	ADD HL, BC	numbers are in inverse video.
	7E	LD A(HL)	
	A7	ADD A	
	20 08	JRNZ +8	
	06 03	LD B, 03	
	23	INC HL	
	36 9C	LD(HL) 9C	
	10 FB	DJNZ -5	
	C9	RET	
	3D	DEC A	
	FE 9B	CP 9B	
	20 05	JRNZ +5	
	36 A5	LD(HL),A5	
	2B	DEC HL	
	18 EA	JR -22	
	77	LD(HL), A	
17017	11 00 30	LD DE, 30 00	Delay loop — governs speed of game,
	1B	DEC DE	to increase speed, reduce value of DE
	7A	LD A,D	
	B3	OR E	
	20 FB	JRNZ -5	
17025	C3 B3 41	JP 16819	GOTO 16819 — start of routine.

MAZE

MAZE GAMES — a well-established part of home computer tradition — offer endless scope for imagination in programming, as well as hours of frustration in the playing. You are always sure that if you try just once more you will succeed. The scenarios of maze-type adventure games are many and varied but the principles are usually very similar. They may be text-only or they may give you a graphic indication of your whereabouts and the consequences of your actions. Your view is generally limited to your immediate surroundings, and the perils you may have to face are many and varied.

The principles of maze construction and the main running routine given here are of general application, whilst the consequence routines give examples of the sort of effects you can produce with a little effort.

The total program given requires that you escape from the maze with as much money as possible, and preferably rescue the dragon from St Clair at the same time, before you run out of time or food, and before you are eaten by a troll or a giant spider.

If you only enter lines 20-260 and from 10000-10110 you can dream up your own consequence subroutines and amaze yourself with your own ingenuity.

A simple method of setting up a maze on the Dragon is to use a variable array. The text screen contains 512 print positions, so this is a convenient number to deal with. Life is actually simpler if the array is rather bigger than this, and adding an extra three lines at the top and bottom gives a total of 672 for the array. Of course, various items also need to be included in appropriate numbers. The array and its contents are dealt with in the routine at 10000.

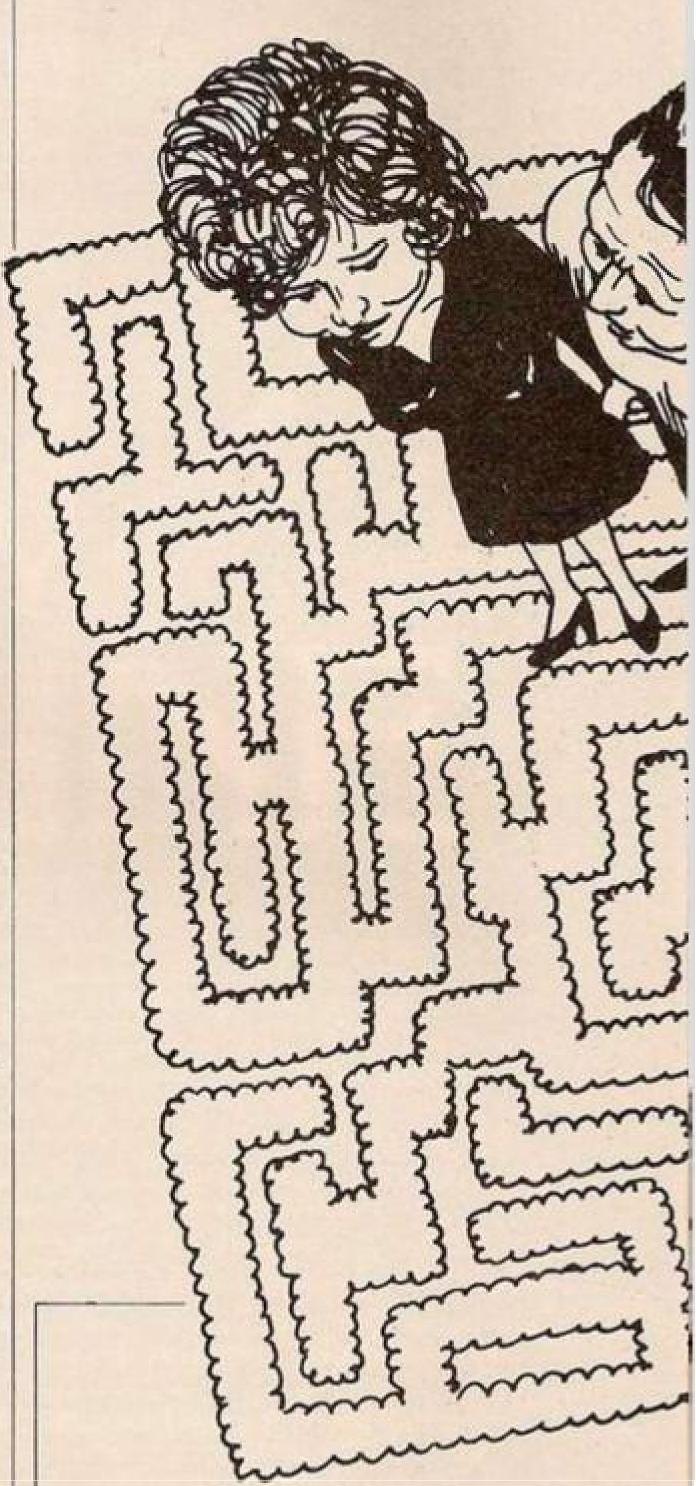
Line 10020 sets up the variables: A1 is the array size; A2 is the screen start; A3 is the screen end; A4 is the screen size; A5 is the number of blocked paths; A6 is the number of items; A7 is the number of space warps; MO is the money; UP is the time allowed; F is food; YU is you.

Line 10030 sets up the array and fills it with CHR$(128) — black. Line 10040 inserts A5 (450) green — CHR$(143) — pathways at random. Line 10050 inserts A6 (50) randomly-coloured blocks at random. Line 10060 inserts A7 (50) space warps — CHR$(144) — but still black, at random.

Line 10070 resets the bottom but one line to green, to give you a chance to escape. Line 10080 sets the way out — O — on the bottom line, and sets you — U — and the dragon — D — in random start positions. Line 10090 checks that you can move in your first turn and if not, redraws the maze. Line 10100 prints the maze on the screen. Line 10110 clears the low- and high-resolution screens and sets the internal timer to zero then leads back to the main running routine at 100.

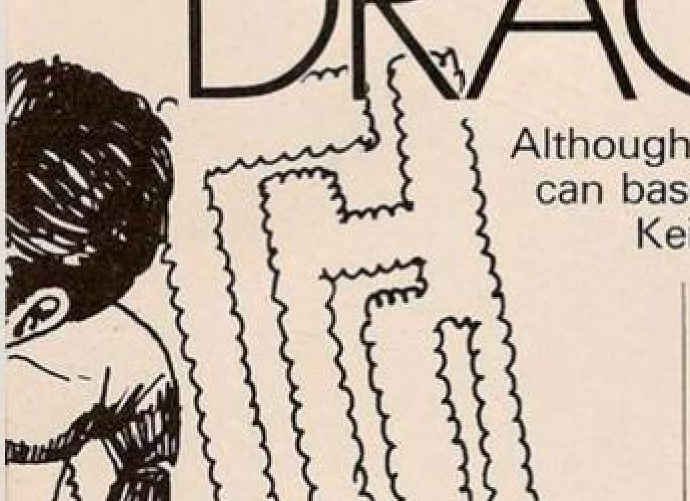
This routine is at the beginning of the program so that it is executed as rapidly as possible. The speed of Dragon Basic is such that this update routine works almost as fast as you can think what to do next.

Line 110 looks at the three lines above and below your present position, prints out the contents of the array for a small distance — C — either side and above and below your



```
10 REM A-MAZ-ING COPYRIGHT K & S
BRAIN NOV 1982
20 GOTO10000
100 CLS:PRINT@224,"TIME",,"MOVES
",,"FOOD",,"MONEY"
110 X=U-99:Y=U+99:Z=Y-X:FORA=0TO
 Z STEP32:FORC=0TO6:PRINT@ (A+C)
,CHR$(B(X+A+C)):NEXTC,A:PRINT@26
2,M
120 T=(INT(TIMER/50)):IFT>UP THE
N12000ELSEPRINT@230,T:PRINT@294,
F:PRINT@326,MO
130 A=JOYSTK(0):AA=JOYSTK(1):IFA
>10ANDA<50ANDAA>10ANDAA<50THEN12
0
140 M=M+1:F=F-1:IFF<1THEN13000
150 IFA<10THENV=U-32
160 IFA>50THENV=U+32
170 IFAA>50THENV=U-1
180 IFAA<10THENV=U+1
190 IFB(V)<>143THEN210
200 B(U)=143:U=V:B(U)=YU:PRINT@3
84,"":GOTO110
210 IFU=0 THEN11000
220 IFB(V)=128THENPRINT@84,"NO W
AY":SOUND1,5:GOTO110
230 IFB(V)=144THEN14000
240 IFB(V)=100THENPRINT@384,"CON
GRATULATIONS",,"YOU HAVE FOUND T
HE DRAGON":YU=117:GOTO200
250 IFB(V)<145THEN110
260 ON(B(V)-143)/16GOTO1000,2000
,3000,4000,5000,6000,7000
1000 F=F+50:PRINT@84,"FOOD":SOUN
D150,5:GOTO200
2000 MO=MO+50:PRINT@84,"MONEY":S
OUND200,5:GOTO200
3000 DATA3,0,4,0,5,0,6,0,7,0,3,1
,5,1,7,1,3,2,4,2,5,2,6,2,7,2,0,3
,1,3,2,3,3,3,7,3,8,3,9,3,10,3,3,
4,4,4,5,4,6,4,7,4
3010 DATA3,5,4,5,5,5,6,5,7,5,3,6
,4,6,5,6,6,6,7,6,3,7,4,7,5,7,6,7
,7,7,3,8,4,8,6,8,7,8,3,9,4,9,6,9
,7,9,1,10,2,10,3,10,4,10,6,10,7,
10,8,10,9,10,1,11,2,11,3,11,4,11
,6,11,7,11,8,11,9,11
3020 C=RND(8):CLS0:FORN=1TO65:RE
ADX,Y:SET(X,Y,C):NEXT:RESTORE
3030 FORN=1TO20:SET(0,2,C):SET(1
0,2,C):FORZ=1TO50:NEXTZ:RESET(0,
2):RESET(10,2):FORZ=1TO50:NEXTZ:
SET(0,4,C):SET(10,4,C):FORZ=1TO5
0:RESET(0,4):RESET(10,4):FORZ=1T
O50:NEXTZ
3040 PRINT@224,"YOU HAVE MET A T
ROLL","WITH A PASSION FOR MONEY!
"
3050 PRINT@320,"UNLESS YOU GIVE
HIM $100","HE WILL EAT YOU!!":NE
XT
3060 PRINT@224,,,,,,,,,,,:PRINT@
224,"YOU HAVE $";MO
3070 IFMO>99THEN3100
3080 SET(0,2,C):SET(10,2,C)
3090 FORN=1TO50:FORM=4TO6:SET(M,
3,C):FORZ=1TO50:NEXTZ:RESET(M,3)
:NEXTM:PRINT@384,"THE TROLL JUST
 ATE YOU":SOUND1,1:NEXTN:RUN
3100 SET(0,4,C):SET(10,4,C)
3110 MO=MO-100:PRINT@352,"YOU HA
D ENOUGH TO PAY THE TROLL":PRINT
@384,"YOU NOW HAVE $";MO;"LEFT"
3120 FORN=1TO20:RESET(6,8):RESET
(6,9):RESET(6,10):RESET(6,11):RE
SET(7,11):RESET(8,11):RESET(8,12
):SET(8,8,C):SET(8,9,C):SET(9,8,
C):SET(9,9,C)
3130 FORZ=1TO50:NEXTZ:SET(6,8,C)
:SET(6,9,C):SET(6,10,C):SET(6,11
,C):SET(7,11,C):SET(8,11,C):SET(
8,12,C):RESET(8,8):RESET(8,9):RE
SET(9,8):RESET(9,9):NEXTN:GOTO10
0
4000 PCLS:PMODE3,1:SCREEN1,0
4010 FORN=1TO16:DRAW"C4":DRAW"S"
+STR$(N):DRAW"A0L18H4U4E4R36F4D4
G4L18C2BM-4,-5LHUERFDGLBM+8,+0LH
UERFDGLBM-3,+5"
4020 FORC=0TO1:DRAW"C"+STR$(C):D
RAW"R4ND12R6ND12R6F4D8U8H4R6F4D8
U8H4L26ND12L6ND12L6G4D8U8E4L6G4D
8U8E4R22":IFC=0THENSOUND(N*15),N
4030 NEXTC,N:IFYU=85THEN4050
4040 CLS4:PRINT@160,"YOU WERE LU
CKY!":PRINT@224,"THE DRAGON FRIE
D THE SPIDER!":FORN=1TO3000:NEXT
:GOTO200
4050 LU=RND(10):IFLU<5THEN4070
4060 CLS2:PRINT@128,"YOU WERE LU
CKY!":PRINT@192,"THE SPIDER COUL
DN'T STAND THE   TASTE OF YOU!":
FORN=10TO250STEP2:SOUNDN,1:NEXT:
GOTO100
4070 CLS0:PRINT@128,"WHAT DOES I
```

MACHINE: DRAGON



Although it's a full game in itself, you can base new subterranean epics on Keith and Steven Brain's maze.

position and prints the move number — M. Line 120 checks if time is up and, if not, prints the time, T; food, F; and money, MO.

Line 130 checks that the joystick is not centred. Line 140 updates the move and food counters and checks for starvation. Lines 150-180 calculate your next position. Line 190 checks if the pathway chosen is clear and, if so, line 200 updates your position. Line 210 checks for the exit, 220 for a blocked pathway, and 230 for a space warp.

Space warps are difficult to avoid, as CHR$ (144) looks exactly the same as CHR$(128). They can be avoided by not bumping against the walls, but sometimes you need to be able to find one to get out of a dead end. Line 240 reports the dragon and converts you into an inverse U. Line 260 directs the program to the various routines dealing with coloured blocks.

The alternative lines 130, 150-180 use the cursor keys in place of a joystick, but we think this makes it too easy as you do not have to remember to centre the joystick to avoid re-entering a disastrous routine.

The routines at 1000 and 2000 simply increase your food and money, and delete these items from the array.

The Troll routine at 3000 uses a mixture of text and low-resolution graphics, and checks for money. Note that data must be restored after use, and that you only need to erase and reconstruct parts which move.

The Spider routine at 4000 uses high-resolution graphics and a scaled draw command. Dragons fry spiders, otherwise you have a 50:50 chance of escaping. Note that only the legs are erased — drawn in background colour — and redrawn for each move, and that the dragon is detected by YU being inverse.

The whirlpool routine at 5000 uses the circle command and both screens — XX=INT (RAND(0) — and loses you a random proportion of your food and money.

The St Clair routine at 6000 checks for the dragon, which he does not like.

The seeing stone at 7000 quickly prints out the whole maze, and the final successful status report is at 11000.

Failure due to time is reported by 12000, and due to starvation at 13000. Finally the space warp routine at 14000 displays a space warp of random length, of random colours, and at a random angle. It can move you anywhere in the maze. ■

```
T FEEL LIKE INSIDE A GIANT SPIDE
R?":PRINT@256,"HARD LUCK!":FORN=
10TO200STEP10:SOUNDN,2:NEXT:RUN
5000 XX=INT(RND(0)):PCLS(RND(4)*
(XX+1)):PMODE3,1:SCREEN1,XX
5010 FORN=1TO150STEP4:CIRCLE(128
,96),N,(RND(4)*(XX+1)),N/300:SOU
NDN,1:NEXT
5020 CLS(RND(8)):PRINT@192,"YOU
HAVE ESCAPED FROM THE","WHIRLPOO
L BUT YOU LOST:",
5030 LM=RND(0):LF=RND(0):PRINT,I
NT(MO*LM);"MONEY",,INT(F*LF);"FO
OD":FORN=1TO5000:NEXT
5040 MO=MO-INT(MO*LM):F=F-INT(F*
LF):GOTO100
6000 CLS4:FORN=1TO32:PRINTCHR$(1
85);:NEXT:PRINT@32,"I'M ST CLAIR
 AND I'LL KILL","ANYONE WHO HELP
S THAT DRAGON!!";:FORN=1TO32:PRI
NTCHR$(185);:NEXT:IFYU=117THEN60
20
6010 PRINT@320,"YOU MUST TELL ME
 IF YOU SEE HIM":FORN=1TO5000:NE
XT:GOTO100
6020 PRINT@288,"DEATH TO ALL YOU
 DRAGON LOVERS!",,"ST CLAIR?":FO
RM=1TO3:FORN=100TO1STEP-5:SOUNDN
,M:NEXTN,M:RUN
7000 CLS2:PRINT@224,"THE SEEING
STONE WILL GIVE YOU","A BRIEF GL
IMPSE OF THE MAZE":FORN=1TO1000:
NEXT
7010 CLS0:FORN=97TO576:PRINTCHR$
(B(N));:NEXT:FORN=1TO250:NEXT:CL
S:GOTO100
10000 CLS:PRINT"    MAZE UNDER C
ONSTRUCTION",,," ";CHR$(85);"= Y
OU",CHR$(100);"= DRAGON",,," ";C
HR$(117);"= YOU + DRAGON",,,,,"
";CHR$(159);"= FOOD",CHR$(175);"
= MONEY",,,
10010 PRINT" ";CHR$(191);"= TROL
L",CHR$(207);"= SPIDER",,," ";CH
R$(223);"= WHIRLPOOL",CHR$(239);
"= ST CLAIR",," ";CHR$(255);"= S
EEING STONE"
10020 A1=672:A2=97:A3=576:A4=447
:A5=450:A6=50:A7=50:MO=100:UP=10
00:F=800:YU=85
10030 DIMB(A1):FORA=1TOA1:B(A)=1
28:NEXT:SOUND1,1
10040 FORA=1TOA5:B(RND(0)*A4+A2)
=143:NEXT:SOUND10,1
10050 FORA=1TOA6:B(RND(0)*A4+A2)
=(RND(7)*16)+143:NEXT:SOUND20,1
10060 FORA=1TOA7:B(RND(0)*A4+A2)
=144:NEXT:SOUND30,1
10070 FORA=513TO544:B(A)=143:NEX
T:SOUND40,1
10080 O=545+RND(29):B(O)=143:U=R
ND(A4)+A2:B(U)=YU:D=RND(A4)+A2:B
(D)=100:SOUND50,1
10090 IFB(U+1)=143ORB(U-1)=143OR
B(U+32)=143ORB(U-32)=143THEN1010
0ELSESOUND1,10:RUN
10100 CLS0:FORA=A2 TO A3:PRINTCH
R$(B(A));:NEXT
10110 FORA=1TO1000:NEXT:CLS:PCLS
:TIMER=0:GOTO100
11000 CLS(RND(8)):PRINT@96,"CONG
RATULATIONS - YOU ESCAPED!",,,"Y
OU TOOK"M"MOVES",,,"YOU HAD:",MO
;"DOLLARS",,F;"FOOD",,(UP-T);"TI
ME LEFT"
11010 IFYU=117THENPRINT@384,"AND
 YOU HAD THE DRAGON WITH YOU!"
11020 FORN=1TO8000:NEXT:RUN
12000 CLS0:PRINT@224,"YOU RAN OU
T OF TIME!",,,"THIS IS THE END O
F YOUR UNIVERSE":FORN=1TO1000:NE
XT:CLS0:FORN=250TO1STEP-1:SOUNDN
,1:NEXT:RUN
13000 CLS0:PRINT@224,"YOU STARVE
D TO DEATH!",,,"BETTER LUCK IN Y
OUR","NEXT REINCARNATION!!":SOUN
D1,50:RUN
14000 PCLS(RND(4)):PMODE3,1:SCRE
EN1,0:FORNM=1TO(RND(4)):FORN=1TO
62STEPNM:DRAW"S"+STR$(N):DRAW"C"
+STR$(RND(3)):DRAW"BM-6,+8U16R12
D16L12BM128,96":SOUND(NM*N),1:NE
XTN:DRAW"A"+STR$(RND(2)):NEXTNM
14010 B(U)=143:U=RND(431)+128:B(
U)=YU:V=U
14020 CLS0:FORN=97TO576:PRINTCHR
$(B(N));:NEXTN:FORN=1TO500:NEXTN
:CLS:GOTO100
```

alternative lines for use of cursor keys instead of a joystick for movement

```
130 I$=INKEY$:IFI$=""THEN130ELSE
I=ASC(I$)
150 IFI=94THENV=U-32
160 IFI=10THENV=U+32
170 IFI=8THENV=U-1
180 IFI=9THENV=U+1
```

TURNING

Turtle graphics are the family of drawing routines at the heart of Logo. Fintan Culwin presents a full turtle program for the BBC Micro.

LOGO IS A computer language and a powerful educational tool. It has many of the characteristics of the almost synonymous Lego, insofar as Logo provides a small number of basic building blocks. The blocks can be put together very easily to produce complicated results.

Logo has no formal syllabus or correct methods. The emphasis is not on learning the facts about Logo, but learning about thought processes that can be extended to other situations. Seymour Papert in *Mindstorms* gives an example of extending Logo ideas to juggling; a skill that I was able to learn in 30 minutes after reading his analysis.

Allowing a child to explore a Logo system by exploring his or her own ideas and being rewarded by feelings of creative and aesthetic achievement uses the most powerful motivating forces. Most educational software is much more conservative, relying on practice rather than creativity and producing external rewards.

As a computer language a full version of Logo should provide the minimal features of a high-level language: loop structures, decision-branching and editing facilities; in addition, a full Logo includes powerful features such as list-processing and recursive functions.

Logo, like Lisp and Forth, is a threaded interpretative language. It provides a small number of system commands which, when referenced, call short machine-code subroutines. The systems commands can be linked together to give a user-defined command which can then be included within a further defined command.

One of the advantages of using Logo as an introductory computer language is that the structuring of programs in Basic follows naturally from this experience. The problems of spaghetti programming are avoided.

Full implementations of the Logo language are rare and expensive. The TI-99/4 version costs £60 and the BBC version is reported to cost £55. It is much more usual to find a subset of Logo commands and facilities related only to controlling a screen object called a turtle. This limited system is known as graphics Logo or turtle talk.

In this program the routines to control the screen are controlled by Basic subroutines. The program also does not allow procedures to be defined with a parameter but does support very powerful use of the Logo variables which can produce the same effect. Designed for use by children, the system is very user-friendly and almost crash-proof. It has been well-tested with groups of children and does provide an effective Logo environment. If your seven-year-old cannot handle Basic, try this instead. You may not need a secondary school if you do.

Commands are given to the system either by using one of the system command mnemonics in table 1 or by giving one of the defined commands. If a system command is given, it may or may not require a parameter. Numeric parameters can be given either as a number or as a term that includes the system variables NM, TR, SZ.

Numeric parameters can be evaluated by the Basic Eval function. If the Eval function is used with a parameter string that cannot be evaluated, an error condition is produced that crashes the system down to its lowest level.

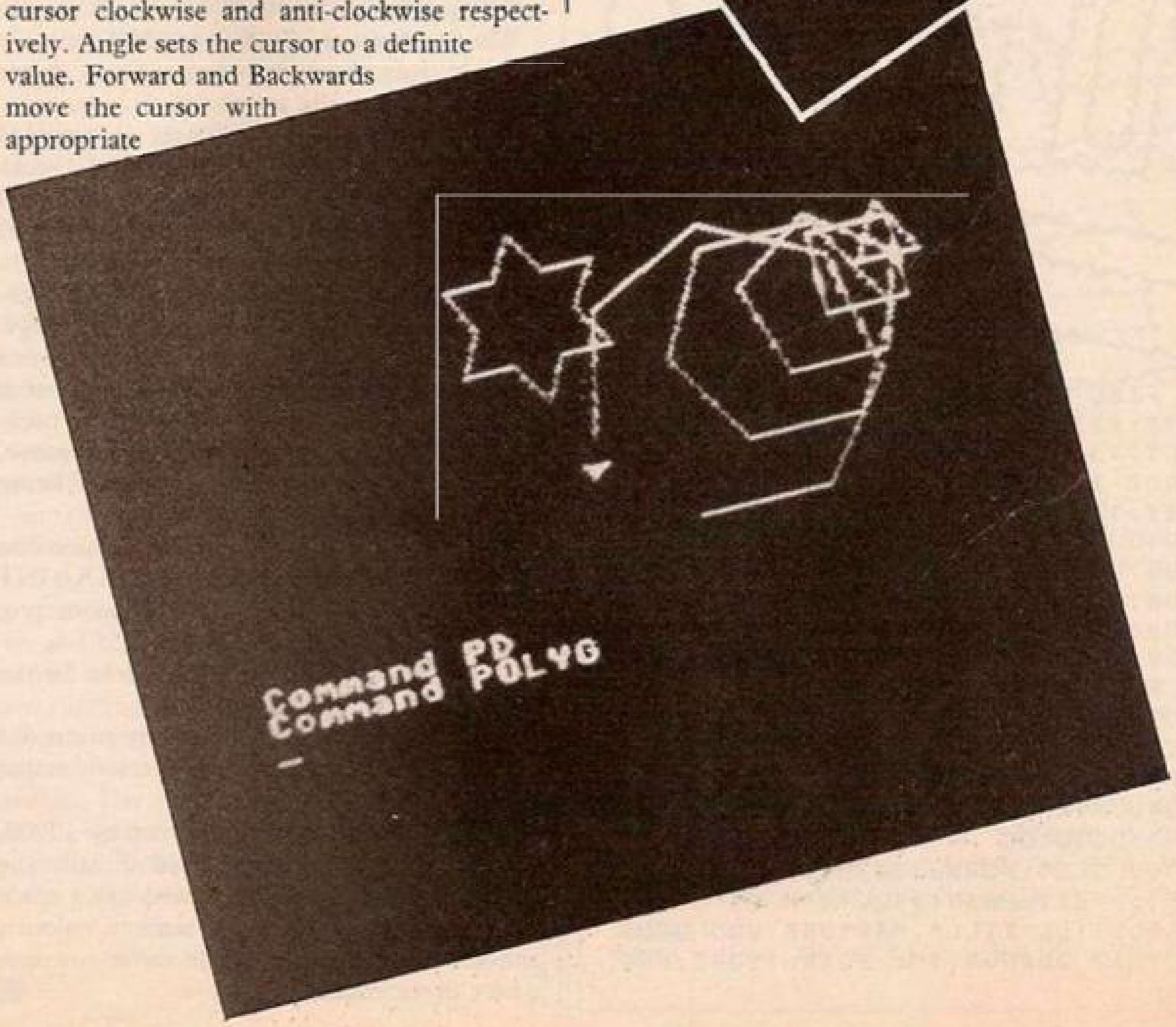
A string parameter is the name of a command; for memory efficiency it should not be longer than eight characters. System commands have to be given to the system as mnemonic space parameters.

Clear Screen clears the screen, resets the angle to 0 and homes the cursor to the centre of the screen. Pen Up and Pen Down set trace output from the cursor off and on. Fill and End Fill fills the areas in the same way as Plot in BBC Basic, starting with the second point after Fill is called. Cursor On and Off switch the cursor on and off. Long procedures can be speeded up significantly by turning the cursor off.

Quit allows you to leave the system to store definitions on tape. The definitions are stored as strings — this is exactly the situation where the most cassette-filing system errors occur so make sure you have your CFS patch in when you use it.

Cursor Right and Down move the cursor around the screen. Use negative parameters to move left or up. Right and Left turn rotate the cursor clockwise and anti-clockwise respectively. Angle sets the cursor to a definite value. Forward and Backwards move the cursor with appropriate








```
L.
    4 REM VER 4YC
    5 ON ERROR GOTO 2500
   20 PROCINT
   30 MODE 7
   40 CLS:FORN%=0 TO 1:PRINTTAB(15,N%)CHR$&8D;CHR$&81;"MYLOG":PRINTTAB(17,N
%+2)"*****":NEXT
   50 PRINTTAB(3,7);"DO YOU WANT TO INPUT DEFINITIONS FROM   A TAPE (Y/N) ?
"
   60 R=GET:IF (R<>78 AND R<>89) THEN 60 ELSE IF R=78 THEN 150
   65 PRINT"PUT DATA TAPE IN RECORDER"'"AND PRESS P.":REPEAT:UNTIL GET=80
   70 ch=OPENIN("MYLOGS")
   80 INPUT#ch,DT
   90 FORN=1 TO DT
  100 INPUT#ch,DT$(N,0)
  110 INPUT#ch,DT$(N,1)
  120 PRINTDT$(N,0),DT$(N,1)
  130 NEXT
  140 CLOSE#ch
  150 MODE 4
  160 PROCSCR:PLOT4,640,412:GOSUB 2190
  170 REPEAT
  180 PROCINP
  190 CN=V1:CM=V2:IF CN<100 THEN PROCACT(CN,CM,V$)
  200 D$(0)=STR$(CN)+" "+STR$(CM)+" "+STR$(AG)
  210 VDU 7
  220AX1=AX:AY1=AY:GA1=GA:AX=(256*(?&33E))+?&33F:AY=(256*(?&33C))+?&33D:GA=
AG
  230 NMO=NM:TRO=TR:SZO=SZ
  240 IF CN>100 THEN CN=CN-100:SC=0:S$(0)=DT$(CN,1):REPEAT:PROCEX:UNTIL SC<
0
  250 UNTIL QU=1
  260 MODE7:PRINT"DO YOU WANT TO SAVE THIS VERSION ?"
  270A=GET:IF(A<>78 AND A<>89)THEN 270 ELSEIF A=78 THEN 380
  280 PRINT"PUT BLANK TAPE IN RECORDER"'"AND PRESS R.":REPEAT:UNTIL GET=82
  290 ch=OPENOUT("MYLOGS")
  300 PRINT#ch,DT
  310 FORN=1 TO DT
  320 PRINT#ch,DT$(N,0)
  330 PRINT#ch,DT$(N,1)
  340 PRINTDT$(N,0),DT$(N,1)
  350 NEXT
  360 CLOSE#ch
  380 *FX 15 ,0
  390 PRINT"DO YOU WANT TO GO BACK TO THE PROGRAM ?"
```

(continued below)

TURTLE

trace output in the direction of the current angle.

Repeat and Next define a repeat loop. Define and End Define delineate a user-defined command. Delete removes a defined command from the system. Describe describes a defined command. Edit allows editing of a command, each term of a command is presented with options of Entering that term, Deleting that term, replacing that term, Inserting a term before the presented term or abandoning the definition. A useful way of turning the screen off while defining a command is to define the command without any terms, then insert the definition using the editor.

System lists the system command available, List lists the defined commands. Undo attempts to undo the last command given. Value lists the values of the three Logo variables Number, Turn and Size.

Now for the program and, to paraphrase Arthur Dent, do not panic. Although the program is 10K of listing, it is not spaghetti-written. This does not necessarily mean that it always conforms to structural programming conventions. A workable, testable version can be produced with a small amount of effort and built up from there.

Begin typing in the driver routine between lines 150 and 250. Add the initialisation procedures ProcInt and ProcScr. The utility routines ProcStrip and ProcFind. ProcStrip removes the front spaces from strings and indicates the place where it can be divided to give a string containing the first value. ProcFind looks for a string among the system commands and defined commands. It returns 0 if no such command exists, a value less than 30 for a system command and a value greater than 100 for a defined command.

(continued on page 67)

Command	Mnemonic	Parameter
Clear screen	CL	—
Home cursor	HM	—
Pen up	PU	—
Pen down	PD	—
Fill	FL	—
End Fill	EF	—
Cursor on	ON	—
Cursor off	OFF	—
Quit	QU	—
Cursor right	CR	N
Cursor left	CL	N
Right turn	RT	N
Left turn	LT	N
Angle	AG	N
Forwards	FD	N
Backwards	BD	N
Repeat	RP	N
Next	NX	—
Define	DF	$
End Define	EN	—
Edit	ED	$
Describe	DS	$
Delete	DL	$
System	SY	—
List	LI	—
Undo	UD	—
Values	VL	—
Number	NM	N
Turn	TR	N
Size	SZ	N

Table 1.

(continued from top of page)

```
  400 A=GET:IF (A<>78AND A<>89)THEN 400 ELSE IF A=78 THEN END
  410 GOTO 150
  420 DEFPROCSCR
  430 QU=0:HD=0
  440 VDU 28,0,31,39,26
  450 VDU 24,0;200;1279;1023;
  460 VDU 29,0;200;
  470 ENDPROC
  480 DEFPROCINT
  490 DIMD$(30),S$(100),DT$(50,2)
  500 AG=0:ED=0:UD=0:NM=10:TR=90:SZ=10
  510 RESTORE 520:FORN=1 TO 30:READ T$:D$(N)=T$:NEXT
  520 DATA CL,HM,PU,PD,FL,EF,CR,CU,LT,RT,BD,FD,RP,NX,DF,EN,UD,SY,LI,ED,DS,D
L,QU,AG
  530 DATA VL,ON,OF,NM,TR,SZ
  540 FLF=0:PD=1:DF=0:RP=0:SC=0:DT=1:ED1=0:QU=0:AX=640:AY=412:GA=0
  550 ENDPROC
  560 DEFPROCINP:V2=0
  570 INPUT"Command "I$:IF I$="" THEN 570 ELSE PROCSTRIP(I$)
  580 I$=MID$(I$,U+1)
  590 PROCFIND(U$):N=FDF
  600 IF RP=1 AND N=13 THEN PRINT"** already repeating. **":GOTO 570
  610 IF RP=0 AND N=14 THENPRINT"** not repeating **":GOTO 570
  620  IF RP=1 AND N>14 AND N<24 THEN PRINT"** repeating can't use ";D$(N);
" **":GOTO 570
  630 IF DF=1  AND N=15 THEN PRINT"** already defining. **":GOTO 570
  640 IF DF=0 AND N=16 THEN PRINT"** not defining **":GOTO 570
  650 IF DF=1AND N>17 AND N<26 THEN PRINT"** defining can't use ";D$(N);" *
*":GOTO 570
  660 IF N=0THEN PRINT"**sorry don't understand. **":GOTO 570
  670 IF((N>6ANDN<14)OR(N=24)OR(N>27 AND N<31)) AND (I$="" )THEN PRINT"** I
 need anumber for that **":GOTO570:ELSE IF((N>6ANDN<14)OR(N=24)OR(N>27 AND
N<31))THEN V2=EVAL(I$)
  680 V1=N:V$=I$:IF(I$=" "OR I$="")THENV$="0":VDU7
  690 ENDPROC
  760 DEFPROCACT(PT,PN,P$)
  810 IF PT=0 THEN ENDPROC
  820 ON PT  GOSUB 840,850,860,870,880,890,900,910,920,930,960,970,1020,950
,1000,950,1180,1190,1200,1210,1380,1470,1520,1530,1540,1550,1560,1570,1590,
1610
  830 ENDPROC
  840 CLG:AG=0:PLOT4,640,412:GOSUB2190:RETURN
  850 GOSUB 2190:PLOT4,640,412:AG=0:GOSUB 2190:RETURN
  860 PD=0:RETURN
  870 PD=1:RETURN
  880 FLF=1:RETURN
  890 FLF=0:RETURN
  900 X1=10*PN:Y1=0:PROCTUR(0,X1,Y1):RETURN
  910 Y1=10*PN:X1=0:PROCTUR(0,X1,Y1):RETURN
  920 PN=-PN
  930 GOSUB2190:AG=AG+PN:IF AG>360 THEN AG=AG-360 ELSE IF AG<0 THEN AG=AG+3
60
  940 GOSUB 2190
  950 RETURN
  960 PN=-PN
  970 X1=(SIN(RAD(AG)))*PN*10:Y1=(COS(RAD(AG)))*PN*10
  980 IF PD=0 THEN PROCTUR(0,X1,Y1):RETURN
```

(listing continued on page 67)

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(listing continued from page 65)

```
 990 IF FLF>0 THEN FLF=FLF+1
 1000 PL=1: PROCTUR(PL,X1,Y1)
 1010 RETURN
 1020 RP=1:RT$=STR$(13)+" "+STR$(PN-1)+" ":REPEAT
 1021 PROCINP
 1030 RT$=RT$+STR$(V1)+" "+V$+" "
 1050IF V1<100 THEN PROCACT(V1,V2,V$) ELSE :SC=0:S$(0)=DT$(V1-100,1):REPEAT
:PROCEX:UNTIL SC<0
 1060 UNTIL V1=14:TRT$=RT$+STR$(16)+" "+STR$(0):RP=0:IF ED=0:S$(0)=TRT$:SC=
0:REPEAT:PROCEX:UNTIL SC<0
 1070 RETURN
 1080 PROCSTRIP(P$):IF P$="0" THEN PRINT"** you need to give it a name ! **
":RETURN
 1090 PROCFIND(P$):IF FDF=0 THEN 1110 ELSEDF=0:IF FDF<100 THEN PRINT"** ";P
$;" is a system command **":ELSE IF FDF-100=DT AND ED1=0 THEN PRINT"** you
are still defining ";P$;" **"
 1100 IF FDF-100<DT AND ED1=0 THEN PRINT"** you have already defined ";P$"
**":RETURN
 1110 IF DT=50 THEN PRINT"## my chips are full ##:R.
 1111 DF=1:P$=U$:DT$(DT,0)=P$:DT$(DT,1)="":REPEAT
 1120 PROCINP: IF V1-100=DT THEN PRINT"** you are still defining ";DT$(DT,0
);" **":GOTO 1120
 1130 DT$(DT,1)=DT$(DT,1)+STR$(V1)+" "+V$+" "
 1150 IF V1<100 THEN PROCACT(V1,V2,V$):IF V1=14 THEN FORN=0 TO1:PROCSTRIP(R
T$):RT$=MID$(RT$,U+1):NEXT:DT$(DT,1)=DT$(DT,1)+RT$
 1160 IFV1>100 THENS$(0)=DT$(V1-100,1):SC=0:REPEAT:PROCEX:UNTIL SC<0
 1170UNTIL V1=16:DT=DT+1:DF=0:RETURN
 1180 PROCUNDO:RETURN
 1190 CLS:VDU 14:FORN=1 TO 30:PRINTD$(N);SPC(8);:NEXT:VDU 15:R=GET:CLS:RETU
RN
 1200  CLS:VDU 14:N=0:REPEAT:N=N+1:PRINTTAB((N-1 MOD 3)*10);DT$(N,0);:UNTIL
(N=50 OR DT$(N,0)=""):VDU 15:R=GET:CLS:RETURN
 1210IF P$="0"THEN PRINT"**edit what ? **":RETURN:ELSE PROCFIND(P$):IF FDF=
0 THEN PRINT"** I don't recognise ";P$;" **":RETURN:ELSE IFFDF<100 THEN PRI
NT"** thats a system command **":RETURN:ELSE EDF =FDF-100
 1220 ED=1: CLS:PRINT"D elete""E nter""R eplace""I nsert""A bandon":VDU
 28,10,31,39,26
 1230 ED$=DT$(EDF,1):TED$=""
 1240 REPEAT
 1250 PROCSTRIP(ED$):ED1=VAL(U$):ED$=MID$(ED$,U+1):PROCSTRIP(ED$):ED$=MID$(
ED$,U+1):ED2$=U$
 1260 IF ED1<100 THEN PRINTD$(ED1);"  ";ED2$:ELSE PRINTDT$(ED1-100,0)
 1270 R=GET:IF(R<>68 AND R<>65 AND R<>69 AND R<>73 AND R<>82)THEN 1270
 1280 IF R=65 THEN 1310:ELSE IF R=68 THEN 1290 ELSE IF R=69 THEN GOSUB 1320
:GOTO 1290: ELSE GOSUB 1350:IF R=73 THEN GOTO 1260 ELSE GOTO 1250
 1290 IF RP=1 AND (ED1=16 OR V1=16) THEN PRINT"** still repeating can't end
**":GOTO 1260
 1291 UNTIL((ED1=16 OR V1=16))
 1300 DT$(EDF,1)=TED$
 1310 ED=0:VDU 28,0,31,39,26:CLS:RETURN
 1320  TED$=TED$+STR$(ED1)+" "+ED2$+" "
 1330 IF ED1=13 THEN RP=1 ELSE IF ED1=14 THEN RP=0
 1340 RETURN
 1350 PROCINP:IF V1=13 THEN RP=1 ELSE IF V1=14 THEN RP=0
 1360 IF LEN(V$)<2 THEN 1370 ELSE IF((INSTR(V$,"NM")>0)OR(INSTR(V$,"TR")>0)
OR(INSTR(V$,"SZ")>0))THEN TED$=TED$+STR$(V1)+" "+V$+" ":RETURN
 1370 TED$=TED$+STR$(V1)+" "+V$+" ":RETURN
 1380 ED1=0:IF P$="0" THEN ED1=1:PRINT"** what command ? **":RETURN
 1390 PROCFIND(P$):IF FDF=0 THEN PRINT"** don't recognise ";P$;" **":RETURN

 1400 IF FDF<100 THEN PRINT"** that's a system command **":RETURN
 1410 FDF =FDF-100
 1420 DC$=DT$(FDF,1):REPEAT PROCSTRIP(DC$):DS1=VAL(U$):DC$=MID$(DC$,U):PROC
STRIP(DC$):DS2=VAL(U$):DC$=MID$(DC$,U)
 1430 IF DS1<100 THEN PRINTD$(DS1);" ,";U$;" *";:ELSE PRINTDT$(DS1-100,0);"
 *";
 1460 UNTIL DS1=16:PRINT:RETURN
 1470 IF P$="0" THEN PRINT"** what command ? **":RETURN:ELSE PROCFIND(P$):I
F FDF=0 THEN PRINT"** I don't know ";P$;"  **":RETURN:ELSE IF FDF <100 THEN
 PRINT"** that's a system command **":RETURN
 1480 C=0:FDF$=STR$(FDF)+" 0 ":REPEAT:C=C+1
 1490 UNTIL ((INSTR(DT$(C,1),FDF$)>0) OR(C=DT-1))
 1500 IF(C<DT-1) OR INSTR(DT$(DT-1,1),FDF$)>0THEN PRINT"** can't needed by
";DT$(C,0);" **":RETURN
 1510 N%=FDF-100:REPEAT:DT$(N%,0)=DT$(N%+1,0):DT$(N%,1)=DT$(N%+1,1):N%=N%+1
:UNTIL N%>=DT:DT=DT-1
 1511 C%=0:REPEAT C%=C%+1
 1512 T$="":REPEAT:PROCSTRIP( DT$(C%,1)):DT$(C%,1)=MID$(DT$(C%,1),U):T%=VAL
(U$)
 1513 IF T%<FDF THEN T$=T$+" "+STR$(T%) ELSE T$=T$+" "+STR$(T%-1)
 1514 PROCSTRIP(.*$(C%,1)):DT$(C%,1)=MID$(DT$(C%,1),U):T$=T$+" "+U$+" "
 1515 UNTIL T%=16
 1516 DT$(C%,1)=T$:UNTIL C%=DT-1:RETURN
 1520 QU=1:RETURN
 1530  GOSUB 2190:AG=PN:GOSUB 2190:RETURN
 1540:PRINTTAB(5);"** NM= ";NM;TAB(15)" **"'TAB(5);"** TR= ";TR;TAB(15)" **
"'TAB(5);"** SZ= ";SZ;TAB(15)" **":RETURN
 1550 IF HD=0 THEN RETURN ELSEHD=0:GOSUB2190:RETURN
 1560 GOSUB2190:HD=1:RETURN
 1570  NM=EVAL(P$)
 1571 RETURN
 1590 TR=EVAL(P$)
 1600 RETURN
 1610 SZ=EVAL(P$)
 1620 RETURN
 1690 DEFPROCEX
 1695 IF SC=100 THENPRINT"## my chips are full ##":ENDPROC
 1700 TX$=S$(SC):PROCSTRIP(TX$):E1=VAL(U$):TX$=MID$(TX$,U):PROCSTRIP(TX$):E
2=VAL(U$):TX$=MID$(TX$,U)
 1710 IF(E1>6ANDE1<14)ORE1=24ORE1>27 THEN E2=EVAL(U$)
 1720 IF E1=16 THEN S$(SC)="":SC=SC-1:GOTO 1760
 1730 IF E1=13 AND E2>1 THEN 1770 ELSE IF E1=13 THEN S$(SC)=TX$:GOTO1700
 1740 IF E1>100 THEN 1800
 1750 PROCACT(E1,E2,U$):S$(SC)=TX$:GOTO 1700
 1760 ENDPROC
 1770 RX$="":RY$=TX$:REPEAT:PROCSTRIP(RY$):E3=VAL(U$):RY$=MID$(RY$,U):RX$=R
X$+U$+" ":PROCSTRIP(RY$):E4=VAL(U$):RY$=MID$(RY$,U):RX$=RX$+U$+" ":UNTIL E3
=14
 1780 EP=INSTR(RX$," 14 0"):RX$=LEFT$(RX$,EP-1):RX$=RX$+" 16 00 ":S$(SC+1)=
RX$
 1790 E2=E2-1:TX$="13 "+STR$(E2)+TX$:S$(SC)=TX$:SC=SC+1:GOTO 1760
 1800 S$(SC+1)=DT$(E1-100,1):S$(SC)=TX$:SC=SC+1:GOTO 1760
 1810 DEFPROCSTRIP(ST$):UU=0
 1820 IF ASC(ST$)=32 THEN ST$=MID$(ST$,2):UU=UU+1:GOTO 1820
 1830 U$="":U=0:REPEAT:U=U+1:IF ASC(MID$(ST$,U,1))<>32 THEN U$=U$+MID$(ST$,
U,1)
 1840 UNTIL (MID$(ST$,U,1)=" " OR U>=LEN(ST$))
 1850 U=U+UU
 1860 ENDPROC
 1880 DEFPROCFIND(FD$):FDF=0:PROCSTRIP(FD$):FD$=U$
 1890 N=0:REPEAT:N=N+1:UNTIL(FD$=D$(N) OR N=30):IF FD$=D$(N) THEN FDF=N
 1900N=0:REPEAT:N=N+1:UNTIL(FD$=DT$(N,0) OR N=DT):IF FD$=DT$(N,0) THEN FDF=
N+100
 1910 ENDPROC
 1920 DEFPROCUNDO:THD=HD:UD=1:GOSUB 2190:HD=1:NM=NMO:TR=TRO:SZ=SZO
 1930 PROCSTRIP(D$(0)):UD1=VAL(U$)
 1940 IF UD1>100 THEN S$(0)=DT$(UD1-100,1):PLOT4,AX,AY:SC=0:REPEAT:PROCEX:U
NTIL SC<0:GOTO 2080
 1950 IF (UD1=1 OR UD1=15 OR UD1=17OR UD1>18 AND UD1<>24) THEN PRINT"** can
't undo ";D$(UD1);" **":GOTO 2080
 1960 T$=MID$(D$(0),U):PROCSTRIP(T$):UD2=VAL(U$):T$=MID$(T$,U)
 1965 GOSUB 2190::PLOT4,AX,AY:GOSUB 2190
 1968 IF UD1=2 THEN GOSUB2190:PLOT4,AX1,AY1:AG=GA1:GOSUB2190
 1970 IF UD1=3 THEN PU=1
 1980 IF UD1=4 THEN PU=0
 1990 IF UD1=5 THEN FL=0
 2000 IF UD1=6 THEN IF FL=1:FL=0:ELSE FL=2
 2010 IF UD1=7 THEN PROCACT(7,-UD2,"")
 2020 IF UD1=8 THEN PROCACT(8,-UD2,"")
 2030 IF UD1=9 THEN PROCACT(9,-UD2,"")
 2040 IF UD1=10 THEN PROCACT(10,-UD2,"")
 2050 IF UD1=11 OR UD1=12THEN GOSUB 2090
 2060 IF UD1=13 AND DF=1 THEN PRINT"** EN defintition and redefine **"
 2070 IF UD1=16 THEN PRINT"** EN DeLete definition **"
 2075 IF UD1=24 THEN GOSUB2190:AG=GA1:GOSUB2190
 2080 HD=THD:GOSUB 2190:UD=0:NM=NMO:TR=TRO:SZ=SZO:ENDPROC
 2090 T$=DT$(0,1):PROCSTRIP(T$):X1=VAL(U$):T$=MID$(T$,U+1):PROCSTRIP(T$):Y1
=VAL(U$)
 2100 T$=DT$(0,0):PROCSTRIP(T$):X2=VAL(U$):T$=MID$(T$,U+1):PROCSTRIP(T$):Y2
=VAL(U$)
 2110 FLF=FLF-1
 2120 DT$(0,1)=DT$(0,0)
 2130 IFFLF<=1 THEN PLOT3,-X1,-Y1:GOTO 2160
 2140 PLOT0,-X1,-Y1:PLOT83,-X2,-Y2
 2150 PLOT1,X2,Y2
 2160 RETURN
 2170 DEFFNCAN(Z):=Z*COS(RAD(AN))
 2180 DEFFNSAN(Z):=Z*SIN(RAD(AN))
 2190 IF HD=1 THEN RETURN
 2200 GCOL3,1
 2210 AN=AG:Z=25:VV%=FNSAN(Z):WW%=FNCAN(Z):PLOT1,VV%,WW%:PLOT0,VV%,WW%
 2220 AN=AG+220:Z=25:V%=FNSAN(Z):W%=FNCAN(Z):PLOT0,V%,W%:PLOT0,-V%,-W%
 2230 AN=AG+140:Z=25:V%=FNSAN(Z):W%=FNCAN(Z):PLOT81,V%,W%:PLOT0,-V%,-W%
 2240 PLOT0,2*-VV%,2*-WW%
 2250 GCOL0,1
 2260 RETURN
 2270 DEFPROCTUR(PL,X,Y)
 2280 IF(PT=9ORPT=10) THENTAG=AG:AG=AG-PN:GOSUB2190:AG=AG+PN:GOSUB2190:ENDP
ROC
 2290 GOSUB2190
 2300 IF UD=1 AND PL=1 THEN PL=3
 2310 PLOTPL,X,Y
 2320 GOSUB 2190
 2330 DT$(0,0)=DT$(0,1):DT$(0,1)=STR$(X)+" "+STR$(Y)
 2340 IF FLF>=3 THEN GOSUB 2370
 2350 ENDPROC
 2370 T$=DT$(0,1):PROCSTRIP(T$):X2=VAL(U$):T$=MID$(T$,U+1):PROCSTRIP(T$):Y2
=VAL(U$)
 2380 T$=DT$(0,0):PROCSTRIP(T$):X3=VAL(U$):T$=MID$(T$,U+1):PROCSTRIP(T$):Y3
=VAL(U$)
 2390 IF UD=1 THEN PL=83 ELSE PL=81
 2400 PLOT0,-X2,-Y2:PLOT0,-X3,-Y3
 2410 PLOT0,X3,Y3:PLOT PL,X2,Y2
 2420 RETURN
 2500 REM
 2505IFERR=26ANDERL=670THENPRINT"### SERIOUS ERROR ###"':IFED=1THEN 2560 EL
SE IF DF=1 THEN 2520 ELSE IF RP=1THEN  2540 ELSE 2600
 2510 PRINT"ERROR NUMBER ";ERR;" AT LINE ";ERL:END
 2520 PRINT"## DEFINITION ABANDONED ##":GOTO 2600
 2540 PRINT"## REPEAT ABANDONED ##":GOTO 2600
 2560 PRINT"## EDIT ABANDONED ##":GOTO 2600
 2600 PRINT"## DON'T DO IT AGAIN ##":R=GET:VDU 28,0,31,39,26:CLS:DF=0:RP=0:
ED=0:DT$(DT,0)="":GOTO 170
```

(continued from page 65)

ProcTur controls plotting lines on the screen and the subroutine called at line 2190 controls the cursor on the screen.

Following this, two of the major routines can be introduced. The ProcInp accepts the commands and passes its results to the major procedure ProcAct. This consists of a Gosub stack which calls routines corresponding to the 30 allowed terms. The simple screen-handling commands can now be keyed in. This will give a minimal system capable of executing commands immediately on the screen.

The system can now be extended by adding the structures that allow it to be described as a language, the Repeat loop, and the definition routine depend upon the ProcEx procedure.

There only remain the parts that make life easier: the Editing, Description Delete and Quit routines to complete the system.

The main variables of the program, besides the flags, are the arrays. D$(30) holds the mnemonics for the system commands. The arrays DT$(50,2) holds the defined command names in DT$(DT,0) and their representation in DT$(DT,1). DT is the defined command counter.

The definition of a command is held in the array as a sequence of pairs of strings. The first string of the pair holds the command number as described in ProcFind, the second string holds a dummy value 0 or a simple numerical value or a term that will give a numerical result when passed to the Basic's Eval function. This is made clearer by an example.

Suppose you defined your first term QSQ as FD NM*.8 // RT 90 this would be stored in DT$(1,1) as " 12 NM* .8 10 90". The command SQ defined as RP 4//QSQ//NX would be stored as "13 4 101 14 0".

The execution of a defined term or a repeat loop is handled by ProcEx; this controls the stack S$(100). The string to be executed is placed on the bottom of the stack and is stripped of pairs of values to be passed to ProcEx. If a repeat loop or a defined term is

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encountered then the relevant string is placed on top of the stack and execution of the stack moves up one level.

In operation, the program, operating system RAM and screen memory occupy 22K of your 32K. This leaves 10K for the program variables and the stack.

It is possible to use up all of this memory before the reserved limit of 50 defined terms and 100 stack levels is fully used. Despite this you may wish to add further system commands. Commands to change foreground and background colours could easily be added by adding subroutines to the subroutine stack.

HOW TO TALK TURTLE

David Peckett's programs allow you to test the water before taking the turtle plunge.

THE ESSENCE of turtle graphics is the "turtle" concept. Imagine a mechanical turtle, crawling over a sheet of paper, drawing a line as it goes. It can do two main things: it can go forward for any distance you may wish, and it can turn right through any angle — a negative angle is the same as a left turn. With these two functions, it is easy to make the turtle draw complex patterns; for instance, the imaginary command sequence:

FWD(10) TURN(90) FWD(10) TURN(90)
FWD(10) TURN(90) FWD(10) TURN(90)

would draw a square of side length 10, leaving the turtle back where it started, facing in the original direction. Try it on a piece of paper.

This simple example should hint at how more complex patterns can be generated. There are, however, several important points about the way in which turtle graphics acts which may not be immediately obvious.

The pattern is drawn from wherever the turtle may be at the start — it takes absolutely no notice of the screen's co-ordinate system. This makes it very easy to draw any pattern anywhere; once you have written a routine to draw the shape you want — the difficult part — you can put the turtle in the correct starting position and set it off. This goes even further, since the pattern may be drawn at any angle, because the turtle simply starts moving in the direction in which it is pointing. Put it in the middle of the screen, turn it right 45° and set it running to draw a diamond.

Turtle graphics make it easy to scale the size of a pattern as well. Suppose in the previous example we had used

FWD(n) TURN(90)

that would draw a square of side length n at any angle, anywhere on the screen.

The final major benefit of turtle graphics is the ease with which routines may be debugged. At its simplest, you can "play turtle". Walk and turn as the program specifies and see if your footsteps trace out the pattern you wanted them to. If they do not, the bug should be obvious immediately. This technique appeals particularly to children of all ages, who can have great fun debugging turtle graphics routines.

What facilities do we need from a turtle graphics system? Obviously, there must be commands to instruct the turtle to go forwards and to turn. There must also be a way to put the beast anywhere on the screen, facing in any direction. Sometimes, we may wish to move the turtle without drawing a line, and so we need ways to switch its pen on and off. Also, since we are using a BBC Micro, there must be a way of changing the Ink colour.

Additionally, it would be useful if we could control more than one turtle simultaneously. The Apple turtle graphics system does not allow this, but it might be very helpful in games to be able to move turtles simultaneously.

As a final refinement, the turtle graphics system should allow us to write any message on the screen at the turtle's present position, without affecting that position.

Take a look now at listing 1, which is a set of procedures to implement all these requirements. Their 'names are in line with the general run of turtle graphics commands.

Note that the listing does not show the arrays which are used in conjunction with the procedures. You need five to support the system:

TRTLX(n) and TRTLY(n)

which contain the turtles' positions in absolute screen co-ordinate terms while

TRTLA(n)

holds the angle at which each turtle is facing, using the convention of "up is 0" and recording the angles in degrees clockwise.

TRTLCOL(n)

holds the logical colour number selected for each turtle — you can alter the logical colours by the usual VDU 19 command. Finally,

TRTLDOWN(n)

is an array whose elements are set to 1 to show that the associated turtle is writing, or 0 if its pen is up. The dimension of all of these arrays, given by "n" represents, of course, how many turtles are available.

Remember, though, that having dimensioned the arrays at the start of your program, there is no need to refer to them again. The procedures in listing 1 keep them completely up to date.

All the procedures have a common syntax, which is of the form

PROname(n,d1. .)

The first item in the brackets is the number of the turtle which is to be addressed. It is followed by the appropriate number of items of data; in most cases, there are no data items, or only one, but the positioning commands

PROCTRTLMOVE AND PROCTRTLSET

take more items of data.

The procedures are thoroughly explained by Rem statements and should be easy to follow, but let us take a closer look at what each one does.

ProcTrtlInt. This procedure simply sets the selected turtle up to a standard starting position. It goes to the centre of the screen, facing up, with its pen down and ready to draw a white line. You would normally use this procedure at the start of a graphics run, but it can be called at any time; the turtle goes straight to the start position, from wherever it may be, without drawing a line.

ProcTrtlMove. This is one of the two fundamental turtle graphics instructions. It

(continued on next page)

Listing 1.

```
L.
10000 REM** BBC Turtlegraphics routines
10010 REM** 26 Sep 1982, by D S Peckett
10020
10030 REM** Put turtle "tno" in centre of screen, pointing up, pen down,
10040 REM** and ready to draw in white
10050 DEF PROCTRTLINIT(tno)
10060 PROCTRTLSET(tno,640,512,0):REM** Position and angle
10070 PROCTRTLPENDOWN(tno):REM** Put the pen down
10080 PROCTRTLPENCOL(tno,7):REM** 7 will select white in any mode
10090 ENDPROC
10100
10110 REM** Move turtle "tno" for "td" units in the direction it is facing.
10120 REM** Keep a record of the position if it goes over the screen edges.
10130 DEF PROCTRTLMOVE(tno,td)
10140 tx=TRTLX(tno)+td*SIN(RAD(TRTLA(tno))):REM** Get the new x-axis position
10150 ty=TRTLY(tno)+td*COS(RAD(TRTLA(tno))):REM** and the y-axis position
10160 PROCTRTLMOVETO(tno,tx,ty):REM** Actually move it
10170 ENDPROC
10180
10190 REM** Move turtle "tno" to (tx,ty), drawing a line in the selected
10200 REM** colour if the "pen" is "down".
10210 DEF PROCTRTLMOVETO(tno,tx,ty)
10220 GCOL 0,TRTLCOL(tno):REM** Select the foreground colour for this turtle
10230 MOVE TRTLX(tno),TRTLY(tno):REM** Put cursor at turtle's current position
10240 PLOT 4*TRTLDOWN(tno),tx,ty:REM** Draw the line, if pen is down
10250 TRTLX(tno)=tx:REM** Reset...
10260 TRTLY(tno)=ty:REM** ..the pointers
10270 ENDPROC
10280
10290 REM** Turn turtle "tno" through "ta" degrees in a clockwise direction.
10300 DEF PROCTRTLTURN(tno,ta)
10310 ta=ta+TRTLA(tno):REM** Get new angle
10320 PROCTRTLTURNTO(tno,ta):REM** Actually set it to the new angle
10330 ENDPROC
10340
10350 REM** Set turtle "tno" to point at angle "ta".
10360 DEF PROCTRTLTURNTO(tno,ta)
10370 ta=ta MOD 360:REM** One revolution only
10380 IF ta>180 THEN ta=ta-360:REM** Adjust the range of angles...
10390 IF ta<-180 THEN ta=ta+360:REM** ...to -180 to +180
10400 TRTLA(tno)=ta:REM** Set it
10410 ENDPROC
10420
10430 REM** Position a turtle
10440 DEF PROCTRTLSET(tno,tx,ty,ta)
10450 TRTLX(tno)=tx
10460 TRTLY(tno)=ty
10470 TRTLA(tno)=ta
10480 ENDPROC
10490
10500 REM** Set turtle "tno" to be ready to draw
10510 DEF PROCTRTLPENDOWN(tno)
10520 TRTLDOWN(tno)=1
10530 ENDPROC
10540
10550 REM** Stop "tno" drawing a line as it moves
10560 DEF PROCTRTLPENUP(tno)
10570 TRTLDOWN(tno)=0
10580 ENDPROC
10590
10600 REM** Select a logical colour for turtle "tno" - usual BBC colour codes
10610 DEF PROCTRTLPENCOL(tno,tcol)
10620 TRTLCOL(tno)=tcol
10630 ENDPROC
10640
10650 REM** Write the string held in "tmess$" at position of turtle "tno"
10660 REM** without disturbing the turtle
10670 DEF PROCTRTLMESS(tno,tmess$)
10680 VDU 5:REM** Merge cursors
10690 MOVE TRTLX(tno),TRTLY(tno):REM** Position cursor
10700 PRINT tmess$;:REM** Print the message
10710 VDU 4:REM** Separate cursors
10720 ENDPROC
```

(continued from previous page)

moves the chosen turtle the defined distance in whatever direction it happens to be facing. The distance is given in terms of the standard BBC graphics layout of 1,280 by 1,024 — thus

PROCTRTLMOVE(2,640)

would move turtle 2 a distance equivalent to half the horizontal width of the screen. If the pen is down, the turtle will draw a line behind it in the selected colour.

ProcTrtlMoveTo. This procedure would normally only be used by ProcTrtlMove but is available at any time, if you insist on using it. It moves the turtle to a position defined by the BBC's normal X, Y system, drawing a line behind it as it goes.

ProcTrtlTurn. The second of the two fundamental turtle-graphics commands, this procedure turns the selected turtle through the given angle, which is defined in degrees. Any angle may be given, including those greater than 360°. Nothing is visible on the screen when you Turn, but the effect appears when the turtle is Moved.

ProcTrtlTurnTo. Like ProcTrtlMove To, this routine is intended for use with other procedures, but is available at any time for setting a turtle up to an absolute angle.

ProcTrtlSet. This routine sets a turtle to any absolute (X, Y) screen position and angle. The turtle moves without drawing a line, but it retains whatever Pen and Colour selections have been made.

ProcTrtlPenDown/Up. These two procedures instruct the selected turtle to start and stop writing respectively.

ProcTrtlPenCol. To choose the colour lines which a turtle is to draw, use this procedure. The colour is defined by a number representing a logical colour — which you may redefine to any true colour by the normal VDU 19 command — and the computer reacts as usual to colour numbers greater than those which are available in the current mode. For instance:

PROCTRTLPENCOL(1,2)

in Mode 0 will actually select logical colour 0, drawing the background colour and erasing whatever it may cross.

ProcTrtlMess. Finally, to write a message at the current position of any turtle, use this. It writes whatever is in the given string without moving the turtle.

You have probably realised that some of these procedures are, actually, redundant in the sense that it is quicker and easier to address the appropriate array directly. In particular, ProcTrtlPenDown/Up/Col can all be performed as simply, and slightly faster, by directly accessing the arrays. They are included, however, to make the set of procedures complete and compatible with any other turtle graphics systems you may come across.

It might be a good idea now to have a look at some examples of turtle graphics in action. Listing 2 gives a very basic, even crude, demonstration.

This is a simple program to draw a line around the screen under control of the left and right arrow keys. As written it will only run on a 32K machine, but it is easy to alter line 120 to, say, Mode 4 in order to get around that problem. The program uses just one turtle, which starts off in the middle of the screen, and then crawls forward.

The heart of the program is the Repeat Unit loop at lines 200-300. These lines repeatedly move the turtle forward and then check to see whether specific keys have been pressed. As you will see from the program the right arrow will turn the turtle right 5° on each pass through the loop, the left arrow will turn it left the same amount, and the U and D keys raise and lower the pen to switch the line off and on.

To change the colour, press C; the program will then wait for one of keys 0 to 7 inclusive to be pressed. Once one is pressed, the turtle will move off again, leaving a trail of the newly selected colour. The whole thing carries on until the Q key is hit.

Two points about the routine may be of interest. CHR$224 is defined — in line 90 — as a little arrow, which moves around with the turtle to show where it is. Without it, you could get lost when the pen is up. Secondly, the keys are interrogated via ?215; this is quicker than the Inkey() function, and makes it easy to react repeatedly to keys which are held down continually, as when the turtle is being turned.

The second example — listing 3 — applies turtle graphics to drawing many copies of the same shape, each one being of a different size and angle. It is a good demonstration of the way in which this type of graphics lends itself to rotating and scaling a display without the need for complex mathematical routines, which would probably otherwise have to be developed especially for each application. The program can be adapted to draw a wide range of shapes but, as it is presented here, it draws a complex spiral pattern which creates an attractive shell-like display.

Its heart is ProcPolyg(n,l,a), which draws an n-sided regular polygon, with a corner at the screen centre, of side length l and at angle a. It uses Turtle 1 to do the job, initially positioning it at screen centre, and then steadily Moving and Turning it to complete the drawing of the polygon.

The advantages of a general routine like this is that it can draw a polygon with any number of sides from three up. The more sides it has, the more the shape looks like a circle; in this case, the program draws 20-sided polygons, which are as near as makes no difference for most purposes to a circle.

The main part of the program is the simple For-Next loop at lines 120-150 which steadily adjust the angle at which the polygon is drawn, while at the same time increasing its size by means of the Length=Length+2 instruction in line 140. The effect as the pattern develops on the screen is of a series of circles which grow as they roll around a central point. ■

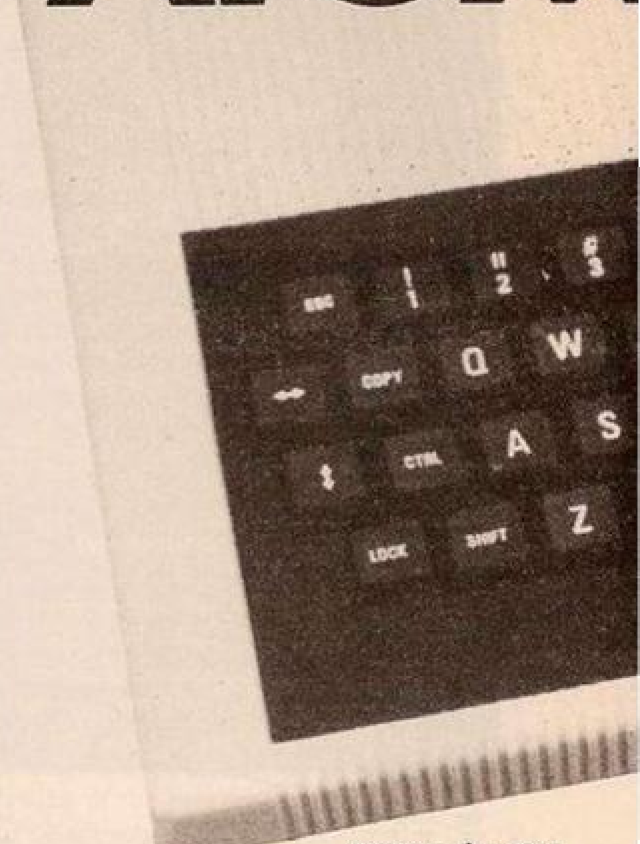
Listing 2.

```
L.
 10 REM** Simple program to demonstrate Turtlegraphics
 20 REM** The turtle moves across the screen, and is steered with
 30 REM** the right and left arrows
 40 REM** The pen can be put up and down, and the colour changed
 50 REM** 29 Sep 1982, by D S Peckett
 60
 70 REM** Set up the arrays needed by Turtlegraphics
 80 DIM TRTLX(1),TRTLY(1),TRTLA(1),TRTLCOL(1),TRTLDOWN(1)
 90 VDU23,224,255,64,32,16,8,0,0,0,0:REM** Pointer character
100 P$=CHR$224:REM** This will show where the turtle is
110
120 MODE1
130 *FX 11,0
140 CLS
150 *FX 4,2
160
170 PROCTRTLINIT(1):REM** Set up turtle 1
180 GCOL 3,7:PROCTRTLMESS(1,P$):REM** Point to turtle
190
200 REPEAT
210   GCOL 3,7:PROCTRTLMESS(1,P$):REM** EOR function flashes the pointer
220   PROCTRTLMOVE(1,7):REM** Move forward 7 units
230   GCOL 3,7:PROCTRTLMESS(1,P$):REM** Flash turtle pointer
240   REM** Use "?215" for high-speed read of keyboard
250   IF ?215=249 THEN PROCTRTLTURN(1,5):REM** Go right?
260   IF ?215=153 THEN PROCTRTLTURN(1,-5):REM** Go left?
270   IF ?215=181 THEN PROCTRTLPENUP(1):REM** "U" to lift pen up
280   IF ?215=178 THEN PROCTRTLPENDOWN(1):REM** "D" to put pen down
290   IF ?215=210 THEN PROCNEWCOL(1):REM** "C" to change colour
300   UNTIL INKEY$0="Q":REM** Quit?
310
320 *FX 4,0
330 *FX11,50
340 END
350
360
370 REM** Choose a new colour
380 DEF PROCNEWCOL(tno)
390 LOCAL tcol$,tcol
400 REPEAT
410   tcol$=GET$:REM** Get a key
420   UNTIL tcol$>="0" AND tcol$<"8":REM** Make sure it's a colour
430 tcol=VAL(tcol$):REM** Convert to a logical colour number
440 PROCTRTLPENCOL(tno,tcol):REM** New colour
450 ENDPROC
```

Listing 3.

```
L.
 10 REM** Draw a spiral pattern with BBC Turtlegraphics
 20 REM** 26 Sep 1982, by D S Peckett
 30
 40 REM** Set up the arrays for turtlegraphics
 50 DIM TRTLX(1),TRTLY(1),TRTLA(1),TRTLCOL(1),TRTLDOWN(1)
 60 MODE4
 70 VDU 19,1,2,0,0,0:REM** Green lines on a black background
 80
 90 REPEAT
100   CLG
110   Length=15:REM** Initial length of each side of the polygon
120   FOR Angle=0 TO 360 STEP 10
130     PROCPOLYG(20,Length,Angle):REM** Draw 20-sided polygons
140     Length=Length+2:REM** Each one will be a little larger
150     NEXT Angle
160   UNTIL GET$="Q":REM** Pause - finish if "Q" is pressed
170
180 END
190
200
210 REM** Procedure to draw an "n"-sided regular polygon, side length "l",
220 REM** with a vertex at screen centre and the first side at angle "a"
230 REM** to the vertical.
240 DEF PROCPOLYG(n,l,a)
250 LOCAL count%,ang
260 PROCTRTLINIT(1):REM** Initialize turtle 1
270 PROCTRTLTURN(1,a):REM** Turn for the first side
280 ang=360/n:REM** Turtle must turn this much at each vertex
290 FOR count%=1 TO n
300   PROCTRTLMOVE(1,l):REM** Draw a side
310   PROCTRTLTURN(1,ang):REM** Turn for the next side
320   NEXT count%
330 ENDPROC
>
```

ATOM



Atomic-powered word processing could make all those Christmas thank-you letters less of a chore. Geoff Byrns shows you how.

A WORD PROCESSOR is ideal for writing reports, newsletters, circulars and personal letters, or for preparing any text where you may wish to make copies or alter slightly before printing. Written mostly in Basic, Scribe allows just such flexibility. Text can be stored to and loaded from tape and a brief rundown of its features will illustrate what Scribe has to offer.

The word processor program has the facility to insert from one to 64 characters of text; to erase single characters or any size block of text; to allow text to be dumped onto tape; and to load text from tape. It can also carry out character or block movement of text, and replace text.

Control codes for the printer are embedded within the text and new lines, tab, and double width characters can all be generated under software control. You can also view text — even though text is echoed to the screen whilst typing it may be desirable to review the text periodically.

Choose your width

The printed line width may be chosen by the user. It is set at 64 and all printing is controlled to disallow broken words at the end of a line.

The program occupies most of the lower text space, including an 800-byte buffer for memory transfers and a scratchpad, but this can be reduced considerably by fully abbreviating the Basic keywords and using multiple-line statements where possible.

Like any piece of software the more you know about it, the more you can get out of it and it becomes possible to alter the program to suit your own purpose. The best way to get to know Scribe is to use it — but first a complete review of its commands is in order.

On running, the program sits and waits with a blank screen for you to type. This could be described as the typing mode, as opposed to the command mode which is described later. in the typing mode all keyboard characters except the Return and Copy keys are accepted as text, which is then copied to the upper text space and echoed to the screen. The upper text space is an ideal repository for text and it allows the equivalent of something like four sides of A4 paper packed with words — enough for most purposes.

Inverse characters are taken to represent upper case, and normal characters represent lower case opposite to the usual practice. In this way, the keyboard is used as one would use a typewriter. Since most mistakes are noticed during typing the normal use of the Delete key is catered for. Incidentally, the Repeat key may also be used with any other key as standard and when any key is pressed, a short blip from the internal speaker is produced which has proved a great aid to typing.

To leave this mode and enter the command mode one merely needs to press the Ctrl key and simultaneously press the Copy key. The Atom responds with a blip and moves the cursor one space forward. At this point, Scribe expects the next key-press to be a command from the following list — an error trap is included for those with shaky fingers should an incorrect key be pressed.

S........Save text

allows text to be dumped to tape. Once this has been successfully saved the routine returns to the typing mode through the View routine.

```
0 REM SCRIBE 2.5 ** (C) G.W.BYRNS 1982
5  DIM H(64),J(64),II(3)
10 A=#8202;B=A;F=0;X=#38E0;O=0
15 W=64 ;REM W=WIDTH CHANGE TO SUIT
20 DIM LL(7);F.I=0TO10;LL(I)=-1;N.
25 F.U=0TO1
30 P=#2800
33 P.#21
35[
40:LL0 JSR#FFE3;STA#80 JSR LL2;LDA#80;CMP@14;BCS LL7
42 JMP LL0;:LL7 RTS
45:LL1 LDA@31;CMP#A0;BCS LL3;LDA#80;JSR#FFF4;:LL3 RTS
50:LL2 LDX@#0F;:LL4 LDA@#FF;STA#81;:LL5 DEC#81;BNE LL5
55 LDA#B002;EOR@4;STA#B002;DEX;BNE LL4;RTS
60:LL6 LDA@8;JSR#FFF4;LDA@32;JSR#FFF4;LDA@8;JSR#FFF4;RTS
100]
105 P.#6;P.#12
110 N.
200 DO; REM ACCEPT TEXT FROM KEYBOARD
203 LI.LL0
205 IF ?#80=127 LI.LL6;A=A-1;?A=#D;G.202
210 ?A=?#80;A?1=#D;A=A+1
215 IF A>#97FC G.t
220 LI.LL1
230 UNTIL ?#B001=191
235 A=A-1;!A=#0D0D0D0D
240 LI.LL0
243 IF ?#80=80 G.p;REM PRINT ROUTINE
245 IF ?#80=75 G.k;REM CONTROL CODE ROUTINE
250 IF ?#80=73 G.i;REM INSERT ROUTINE
255 IF ?#80=86 G.v;REM VIEW ROUTINE
260 IF ?#80=83 G.t;REM SAVE ROUTINE
265 IF ?#80=76 G.u;REM LOAD ROUTINE
270 IF ?#80=69 G.e;REM ERASE ROUTINE
275 IF ?#80=82 G.r;REM REPLACE ROUTINE
280 IF ?#80=77 G.m;REM MOVE ROUTINE
298 IF ?#80>27 P.'"wrong key ","TRY AGAIN";G.200
299 END
300pA=B;M=0;P.#12;P.#21;P.#2
305 P.#32
310 DO
315 IF ?A<16 OR ?A>159 G.c
320 GOS.l;REM FIND LENGTH OF WORD
325 IF M>W P.#13;M=0;O=O+1;IF O>59 GOS.a
330 M=M+L
335 IF M>W P.#13;M=0;M=M+L;O=O+1;IF O>59 GOS.a
350 F.T=0 TO L-1
355 IFA?T=32;P." ";G.370
357 IF A?T<65 A.A?T>32;P.$(A?T);G.370
360 P.$(A?T:#20);REM U/LOWER CASE CONVERSION VICE VERSA
370 N.
375 GOS.s;REM ECHO TO SCREEN
380 A=A+L
390 U.?A=#D
395 P.#13
400 P.#6;P.#3;G.200
500lL=0
510 DO
512 IF ?A>128 G.517
515 L=L+1
517 A=A+1
520 U.?A=32 OR ?A=#D OR ?A>128
530 A=A-L;R.
600sP.#3;P.#6;F.T=0 TO L-1
610 P.$(A?T)
620 N.;P.#21;P.#2;R.
800cIF F=1 AND ?A=161;P.#15;F=0;G.850
805 IF ?A=161;P.#14;F=1
810 IF ?A=162;P.#13;P.#32;M=0;O=O+1
820 IF ?A=163 M=M+8;F.I=0 TO 7;P.#32;N.
850 A=A+1;G.315
900kLI.LL0
905 IF ?#80=68;?A=161
910 IF ?#80=78;?A=162;P.$#A;P.$#D
915 IF ?#80=84;?A=163;P."     "
950 A=A+1;?A=#D;G.200
1000iP.'';IN."INSERT TEXT FROM"'$J
1010 IN."TEXT TO BE INSERTED"'$H
1015 II(0)=A;II(2)=A;A=B
1020 GOS.f;REM FIND MATCH BETWEEN $J AND TEXT
1025 IF F=0 GOS.b;G.i
1030 A=A+LEN(J);D=LEN(H)
1035 GOS.o
1036 G.1090
1040oDO ;REM OPEN TEXT WINDOW TO ALLOW INSERTION
1050 II(3)=II(0)+D
1060 ?II(3)=?II(0)
1070 II(0)=II(0)-1
1080 U. II(0)<A;R.
1090 F.I=0 TO LEN(H)-1
1100 A?I=H?I
1110 N.
1120 A=LEN(H)+II(2);G.v
1500fF=0
1510 DO
1520 IF ?A=?J GOS.w
1530 A=A+1
1540 UNTIL ?A=#D OR II(1)=LEN(J)
1550 A=A-1
1560 IF II(1)=LEN(J);F=1
1570 II(1)=0;R.
1600wII(1)=0
1610 F.I=0 TO LEN J-1
1620 IF A?I<>J?I;I=LEN J;G.1640
1630 II(1)=II(1)+1
1640 N.;R.
1700vP.#12;P.#14
1705 F.I=0 TO A-B-1
```

SCRIBE



L........Load text

allows text loading from tape. A beep signals successful loading and loaded text is automatically displayed. The text may then be added to or manipulated.

I.........Insert text

Respond to the prompts as they appear and single characters, words or sentences — up to 64 characters long — may be inserted anywhere within the text. Remember that the ASCII code 32 is a space and just as much a valid character as any other — so if you want to insert a word or sentence after another word, treat the space as a normal character.

E........Erase text

Allows for single characters, words or entire blocks of text to be erased. Again respond to prompts as they appear treating a space as previously outlined.

M........Move text

allows any amount of text up to 800 characters to be moved from anywhere to anywhere within the text.

R........Replace text

offers a full global search and replacement facility. The replacement can be longer, shorter or the same length as the target text since the routine contains the necessary logic to cater for all circumstances.

The global search and replace is the default condition but you also have the option to operate only on the first target found. This is achieved by appending the replacement word with a] as the final character before Return is pressed. This is an extremely useful and powerful command but under extreme circumstances it may be moving the equivalent of several hundred K of RAM around, so be patient. This command has a great many uses, one of which would be to personalise standard letters, for instance, every occurrence of Mr Smith could easily be replaced by Mr Winterbotham throughout the entire text with one simple command.

Viewing text

Another obvious example is when spelling or typing errors have crept into the text unnoticed; again these can simply and easily be replaced by the R command.

V........View text

This routine prints the entire contents of text to the screen in paged mode. Printer controls are displayed as graphics characters so it is easy to see where, and how many, codes are embedded in the text. The function can be aborted at any time by pressing the Shift key, whereupon a return to the typing mode is executed. It is unfortunate that the Atom screen is fixed at 32 columns wide, since the ideal would be to have the same width screen as the printer, but in practice I have not found this to be detrimental to the layout of any printed matter.

K........Printer control codes.

This is really a command with sub-commands. On entering the command mode by pressing the Ctrl and Copy keys, then pressing K steers the user to a routine which expects one of three other keys to be pressed. These are D, N, T.

D toggles on the double-width printing and all characters encountered after this control code are double printed until the next D code turns off the effect.

All these control codes are transparent to the user — that is, they do not appear on the screen or get printed out. But you can see them when you use the V view command. The N code forces a new line in the Printed output and is useful in producing the desired layout.

The T code produces a tab of eight spaces. I have implemented a software Tab in this application since different printers have different methods of implementing the same by hardware — so this method should be universal but could easily be substituted to suit your own printer. Any number of the N and T codes may be used to obtain the desired format.

P........Print text

Once this command has been invoked the text is sent to the printer formatted according to the control codes. The routine also ensures that no broken words are printed at the end of lines and auto-paging of the document is under software control. During printing the text is echoed to the screen.

The program itself is modular in its approach. I trust this can be seen form the Rem statements in the listing, which incidentally should be omitted from the working copy of the Program since some of the coding will thn occupy the buffer space. ■

```
1707 IF ?#B001<>255 I=A;P.'';G.1720
1710 P.$(B?I)
1720 N.
1725 P.$15;G.200
1800tP.$12;?#8200=A%256;?#8201=A/256
1810 Z=FOUT""
1812 BPUT Z,#AA;WAIT
1815 E=B-2;PUT Z,(A-E)
1820 F.I=E TO A
1825 BPUT Z,?I;WAIT
1830 N.
1840 G.v
1850uP.$12;Z=FIN""
1855 E=B-2;DO U. BGET Z=#AA
1860 I=GET Z
1865 F.N=0 TO 1
1866 E?N=BGET Z
1870 N.;P.$7
1880 A=?#8201*256+?#8200
1885 G.v
1900eP.''';IN."ERASE FROM"$J
1910 II(0)=A;A=B
1920 GOS.f
1925 IF F=0 GOS.b;G.e
1930 A=A+LEN(J)
1940 II(3)=A
1950 P.';IN."ERASE TO"$J
1960 GOS.f
1970 D=A-II(3)
1980 I=0
1990 DO
1995 ?(II3+I)=A?I
2000 I=I+1
2010 UNTIL II(3)?I=#D
2020 A=II(0)-D
2030 G.v
2100bP.'$J" HAS NOT BEEN LOCATED"';R.
2200hF.I=0 TO LEN(H)-1;REM WRITE IN NEW TEXT
2210 A?I=H?I
2220 N.;A=A+LEN(H);R.
2500aP.$13;F.I=0 TO 4;P.$13;N.;O=0;R.
3000rG=0
3010 P.';IN."REPLACE THE FOLLOWING"'$J
3020 IN."WITH "'$H;Z=0
3025 IF H?(LEN H-1)=93 Z=1;H?(LEN H-1)=13
3030 II(0)=A;II(2)=A;A=B
3040 IF LEN(H)>LEN(J) G.4010
3050 IF LEN(H)<LEN(J) G.5010
3060 DO
3070 GOS.f
3080 IF F=0 AND G=0 GOS.b;GOS.d;G.4000
3090 G=1
3095 IF F GOS.h
3097 IF Z F=0;A=II0
4000 UNTIL F=0;A=II(0)
4005 G.v
4010 D=LEN(H)-LEN(J)
4015 DO
4020 GOS.f
4030 IF F=0 A. G=0 GOS.b;GOS.d;G.5000
4035 G=1
4040 IF F GOS.o;GOS.h;II(2)=II(2)+D;II(0)=II(2)
4050 IF Z F=0
5000 UNTIL F=0
5002 A=II2
5005 G.v
5010 DO
5020 GOS.f
5030 IF F=0 A. G=0 GOS.b;G.6020
5035 G=1
5040 D=LEN(J)-LEN(H)
5050 IF F=0 G.6020
5055 GOS.h;II(2)=II(2)-D
5060 I=0
5070 DO
5080 A?I=A?(I+D)
5090 I=I+1
6000 UNTIL A?I=#D
6010 IF Z F=0
6020 UNTIL F=0
6025 A=II(2)
6030 G.v
6100mP.';IN."MOVE TEXT BEGINNING"'$J
6110 P.';IN."ENDING"'$H
6115 II(0)=A;A=B
6120 GOS.f
6125 II(2)=A;$J=$H
6130 GOS.f
6135 E=A+LEN(J)
6140 D=E-II(2)
6145 IF D>800 P."BLOCK TOO LARGE";G.m
6150 F.I=0 TO D
6155 X?I=II(2)?I
6160 N.
6165 I=0
6170 DO
6175 ?(II2+I)=E?I
6180 I=I+1
6185 UNTIL II(2)?I=#D
6190 II(0)=II(0)-D;E=II(0)
6195 P.';IN."PLACE BUFFER AFTER"'$J
7000 A=B;GOS.f;A=A+LEN(J)
7005 GOS.o
7010 F.I=0 TO D-1
7015 A?I=X?I
7020 N.;A=E+D;G.v
7100dF.I=0TO100;WAIT;N.;R.
```

ZX-81 LIFE

Life is what you make it, and Peter Whittle certainly puts some zest into the generation game.

COMPLICATED PATTERN manipulation games such as John Conway's Life are ideally suited for programming on to a computer with visual display. Generally speaking, a lot of simple computation has to be performed to generate each new pattern from the previous one. This computation normally takes the form of checking the adjacent positions of each part of the pattern and then applying simple rules in order to generate the new pattern or, in the case of Life, the new generation.

This non-arithmetic computation is very inefficiently performed when written in Basic, involving many slow For-Next loops. With the game of Life on the ZX-81 it typically takes 20 seconds or more per generation. However, this type of computation is ideally suited for a fairly simple machine-code routine.

The display of the ZX-81 can be looked on as an array of 768 squares arranged in a grid 32 across by 24 down. The normal Basic print statements can only use the top 22 lines, the bottom two being used for report codes, although the whole 24 lines are accessible to a machine-code routine. When the total amount of memory exceeds 3.25K a clear screen is padded out with 24 by 32 spaces.

The computer blocks off 793 bytes of the memory to store this display, the extra bytes being Newline characters to mark the end of each line. The character at each position is coded with a number as listed at the back of the ZX-81 handbook. The starting address of this display file is stored at locations 16396 and 16397 and, in general, may move around in the memory — so its position must be checked each time the routine is called.

The game of Life

Briefly, the game of Life is as follows. Imagine a rectangular array of squares — in the case of the ZX-81 display, 24 by 32 in size. A pattern is first of all set up on the array either by a series of suitable print statements or by a more flexible program as suggested below. Certain rules are then repetitively applied to the pattern which will, in general, change the pattern at each step. If a suitable starting pattern is used a very interesting development of shapes can be observed.

The rules to be observed are as follows: first, any square surrounded by less than two, or more than three, occupied neighbouring squares will die of loneliness or overcrowding respectively. Secondly, any square surrounded by three occupied squares will become occupied, that is, live. Third, any square surrounded by two occupied squares remains unchanged. As can be seen, for each position on the array on which the game is to be played, the eight immediately adjacent positions need to be examined to determine whether it lives or dies.

With all thé For-Next loops needed to program this in Basic, it could take a very long time to run. However, with the machine-code routine to be described, even in Slow mode where the microprocessor has to share its time between executing the program and generating the display, each generation still takes less than one second.

LOCATION	DECIMAL	LABEL	INSTRUCTION	COMMENT
16514	203,86	CHECK	BIT 2,(hl)	Bit 2 set?
16516	40,1		JRZ 1	
16518	60		INC a	Yes
16519	35		INC hl	
16520	201		RET	
16521	42,12,64		LD hl,(16396)	Display file start
16524	35		INC hl	
16525	14,22		LDc,22	Line count
16527	6,30	CH2	LDb,30	Column number
16529	17,30,0	CH1	LDde,30	
16532	175		X OR a	Reset count
16533	205,130,64		CALL CHECK	
16536	229		PUSH hl	For next position
16537	205,130,64		CALL CHECK	
16540	205,130,64		CALL CHECK	
16543	25		ADD hl,de	For next line
16544	205,130,64		CALL CHECK	
16547	229		PUSH hl	For square being tested
16548	35		INC hl	
16549	205,130,64		CALL CHECK	
16552	25		ADD hl	
16553	205,130,64		CALL CHECK	
16556	205,130,64		CALL CHECK	
16559	205,130,64		CALL CHECK	
16562	225		POP hl	Square being tested
16563	87		LDd,a	d has count
16564	62,3		LDa,3	
16566	186		CP d	d = 3?
16567	40,8		JRZ,LIVE	Jump if yes
16569	61		DEC a	Else
16570	186		CPd	d = 2?
16571	32,8		JRNZ,DEAD	Jump if no
16573	203,86		BIT 2,(hl)	Is bit 2 set also
16575	40,4		JRZ,DEAD	Jump if no
16577	203,198	LIVE	SET 0,(hl)	
16579	24,2		JR,OUT	
16581	203,134	DEAD	RES 0 (hl)	
16583	225	OUT	POP hl	Next position in hl
16584	16,199		DJNZ,CH1	End of row?
16586	35		INC hl	Yes
16587	35		INC hl	
16588	35		INC hl	
16589	13		DEC c	Reset line count
16590	32,191		JRNZ CH2	Last line?
16592	30,52		LD e,52	Yes
16594	42,12,64		LD hl,(16396)	Display file
16597	1,33,0		LD bc,33	
16600	9		ADD hl,bc	Start position
16601	14,22		LD c,22	Line count
16603	6,33	ST2	LDb,32	Row count
16605	35	ST1	INC hl	
16606	203,70		BIT 0,(hl)	Bit 0 set?
16608	32,4		JRNZ,LIFE	Jump if yes
16610	175		X OR a	zero a
16611	119		LD(hl),a	Kill
16612	24,1		JR,OUT	
16614	115	LIFE	LD(hl),e	New life
16615	16,244	OUT	DJNZ,ST1	End of line?
16617	35		INC hl	Yes
16618	13		Dec c	Line count
16619	32,238		JRNZ,ST2	Last line?
16621	201		RET	Yes

Figure 1.

Loops are performed most efficiently in machine code by setting a count in one of the registers — normally b, c, d or e so that a, or accumulator may be used for arithmetic and the hl pair for register indirect addressing. Each time the program section is to be executed, the count is decremented by one and then checked for zero with the JRZ or JRNZ instructions; do a relative Jump if JRZ is zero or JRNZ is not zero respectively and the loop either repeated or not.

The most efficient register to use is the b register because there is a special instruction DJNZ which decrements b and tests for zero in one. Another instruction type that is used in the program is the bit set and test group.

In the game of Life the whole pattern is scanned and a new pattern is formed according to the rules previously defined. In order to avoid Saving this new pattern in its own part of the memory and then transferring it into the display file, the life/death decision is made and then the square marked in a way that will be invisible to the status-checking routine when it is called for the neighbouring squares. The newly-formed pattern must be kept separate so as not to interfere with the testing of adjacent squares. The square marking is done by setting and testing particular bits of the word, coding each position in the display.

On the ZX-81, O, the character we will use to define the pattern, is coded 34H or 00110100. Counting the bits from the right, starting at 0 we see that bit 2 is a 1. The instruction BIT2 will test this particular bit

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and set the zero flag — if the bit is a zero — and reset it if the bit is a 1. The zero flag can then be tested by a JRZ or JRNZ instruction. SET and RES will similarly set or reset the particular bit specified.

The only other instructions that may be new to beginners in machine-code programming — although, of course, familiar to regular readers of *Your Computer* — are Push and Pop. These use an area of memory set aside by the computer-operating system for temporary storage. This is called the stack and works on a last-in, first-out principle. Data in the form of 16-bit words is entered or Pushed into the stack or retrieved or Popped from the stack.

The stack pointer, a register we need not worry about here, automatically keeps track of the current top-of-stack position. These instructions are used to temporarily store data out of the way, while the computer gets on with something else. For the readers who missed out, *Your Computer* ran a series on machine code from August to November 1982.

The complete machine-code routine is shown in figure 1. Briefly, its operation is as follows: the whole display is scanned and for each square the bit-checking subroutine, Check, is called for each of the eight surrounding squares, with a count of the number of live ones found and kept in the A register, program location 16525 to 16561.

The count is then checked and bit 0 set or reset accordingly 16563 to 16582. Incidentally, this bit setting and resetting will produce an intermediate pattern of Ps and ■s, that is, the codes 00110101 and 00000001 in the display file. Once the whole array has been processed, it is scanned once more and for each equare, bit 0 is tested to determine its new status and a 0, or 52 substituted for death — a 0 — or life — the letter O — respectively — 16594 to 16621. And that is all there is to it.

The program is loaded into the first Rem statement as suggested by Sinclair, so type out the following; remember to follow the first Rem with 110 spaces, approximately 4 lines.

```
1 REM
10 LET L=16514
20 PRINT L,
30 INPUT I
40 POKE L, I
50 PRINT PEEK L
60 LET L=L+1
70 GO TO 20
```

On running this program it will print out the location. You then type in the decimal numbers as listed in figure 1. Note that some instructions consist of two or more numbers. The screen printout will show that they have been entered properly. When the screen is full type Cont to continue. When you get to 16622 type Stop. The machine-code routine will now be loaded in the Rem statement. All it needs now is a Basic set-up and operating program with some user-friendly embellishments.

```
1 REM....etc
10 LET L=PEEK 16396+256 * PEEK 16397
20 PRINT "           """"LIFE""""
21 PRINT
25 PRINT " MOVE CURSOR WITH ARROWS "
26 PRINT " PRESS O TO WRITE"
27 PRINT " PRESS P TO START "
28 PRINT " PRESS ANY KEY TO RUN AND BREAK TO STOP "
29 PRINT " WHEN READY PRESS CONT "
30 STOP
31 CLS
32 LET A=345
40 LET B=A
50 IF INKEY$="5" THEN LET A=A-1
60 IF IN KEY$="6" THEN LET A=A+33
70 IF INKEY$="7" THEN LET A=A-33
80 IF INKEY$="8" THEN LET A=A+1
81 IF A<1 THEN GOTO 32
82 IF A>724 THEN GOTO 32
85 IF PEEK (L+A)=118THEN GOTO 32
87 IF A< >B THEN POKE (L+B), 0
90 POKE (L+A), 146
100 IF INKEY$<> "O" THEN GOTO 130
110 POKE (L+A), 52
120 LET A=A+1
130 IF INKEY$="P" THEN GOTO 140
135 GOTO 35
140 POKE (L+A), 0
141 LET A=1
147 PRINT AT 0, 18; "GENERATION"; A
150 IF INKEY$= " " THEN GOTO 150
160 LET L=USR 16521
165 LET A=A+1
170 GOTO 147
```

■

```
10 DIM A$(20)
20 POKE 106,PEEK(106)-8
30 GRAPHICS 17:POKE 708,180:POKE 709,124:POKE 710,160:POKE 711,50:POKE 712,4
40 P=PEEK(106):N=P*256
50 FOR M=0 TO 1023:POKE N+M,PEEK(57344+M):NEXT M
60 FOR M=0 TO 103:READ D:POKE N+M+8,D:NEXT M
70 POKE 756,P:A$="$$$$$$$$$$$$$$$$$$$$"
80 FOR M=1 TO 4:POSITION 0,13+M:PRINT #6;A$(1,M+2);CHR$(37);CHR$(38);:NEXT M
90 PRINT #6;CHR$(163);" ";CHR$(39);CHR$(163)
100 POSITION 18,16:PRINT #6;CHR$(163);CHR$(41)
110 POSITION 16,17:PRINT #6;CHR$(39);CHR$(40);A$(1,2);A$;A$;A$;A$
120 PRINT #6;" CHARACTER SET DEMO":POSITION 0,13:PRINT #6;CHR$(163)
130 POSITION 0,0:PRINT #6;CHR$(129);CHR$(130);"       ";CHR$(135);CHR$(137);CHR$(130)
140 POSITION 8,8:PRINT #6;CHR$(135):POSITION 17,10:PRINT #6;CHR$(129);CHR$(130)
150 SOUND 0,50,6,6:SOUND 1,51,4,4
160 POSITION 11,12:PRINT #6;CHR$(10);CHR$(11):POSITION 5,8:PRINT #6;CHR$(10);CHR$(11)
170 FOR D=0 TO 25:NEXT D
180 POSITION 11,12:PRINT #6;CHR$(12);CHR$(13):POSITION 5,8:PRINT #6;CHR$(12);CHR$(13)
190 FOR D=0 TO 25:NEXT D:GOTO 160
200 DATA 0,3,15,31,63,255,255,0,0,192,224,248,252,255,255,0
210 DATA 60,126,255,255,126,24,24,24
220 DATA 255,255,255,255,255,255,255,255
230 DATA 192,224,240,254,255,255,255,255
240 DATA 0,0,0,0,0,0,240,252,0,0,0,0,0,12,126,255
250 DATA 0,0,0,1,63,127,255,255,15,63,127,127,255,255,255,255
260 DATA 1,3,63,202,74,63,31,7,128,192,252,171,170,252,248,224
270 DATA 1,3,63,213,85,63,31,7,128,192,252,83,82,252,248,224
```



ONE OF THE best features of the Atari 400 and 800 computers is the facility to redefine character sets. One can create as many character sets as the imagination can conceive and the computer's memory will hold.

This makes it possible to hold and display instantly any one of a number of character sets, or change the characters at the push of a button. Furthermore, by using Display List Interrupts different character sets can be mixed on the same screen in virtually any way. But perhaps the most interesting thing about a character set is that it takes up just 1K of RAM; imagine, the Latin, Cyrillic and Norse alphabets in 3K, and each one selectable at will.

To create your own character set the first thing to do is decide where in memory to store it. This is because the character set must not be overwritten by a Basic program and must not interfere with an area of memory already used for something else, for example, DOS.

The ideal place is at the top of the available memory. To ensure that it is protected from Basic, first determine the amount of RAM and then subtract from this the amount of memory to be used. Next, the operating system must be fooled into thinking that it only has this reduced RAM capacity available.

Memory location 106 contains the number of pages that are available for use by Basic; a page is 256 bytes long. This location is set by the operating system immediately after switching on the computer and, during a system Reset, this means one is free to alter the value stored there at will. Therefore, placing a smaller number in it can seal off the amount of memory required for use. This is achieved by using the following program.

```
10 GRAPHICS 0
20 POKE 106,PEEK(106)-8
30 P=PEEK(106)
40 N=P*256
```

Line 20 subtracts eight from the number of pages Basic can use. Four of these pages are for use by the new character set; 4*256 = 1024 or 1K. The other pages are used by the display; if a higher resolution mode than Graphics 0, 1 or 2 is used then more pages will have to be set aside for the display's use.

Line 30 sets P equal to the number of pages Basic can use; N in line 40 is given the number for the start of the new character set.

If we are not going to redefine a complete character set and wish to retain the use of part of the original set then the internal characters in ROM must be transferred to the space reserved in RAM. To do this, enter this program line:

```
50 FOR M=0 TO 1023 : POKE N+M,
   PEEK(57344+M) : NEXT M
```

The original character set resides in ROM at location 57344 onwards. N, as we know, contains the starting address of the new character set.

Before designing the new character set we must understand how a byte can represent a decimal number. Look at the following diagram — bit numbers are shown in the top line, decimal in the bottom line.

7	6	5	4	3	2	1	0	
1	0	0	1	0	1	1	0	= 150
128	64	32	16	8	4	2	1	

As you can see, a byte is made up of eight bits, each bit can contain a 1 or a 0 and, further, each bit is assigned a decimal value as

shown. This means that if a 1 was placed in bit 7 then that byte would have a decimal value of 128. In the example bit numbers 1, 2, 4 and 7 contain 1s. This makes the value of the byte equal to 2+4+16+128=150. Each character is made up of eight bytes and so can be thought of as an eight-by-eight square and, depending on which bits in this square are at 1 and which are at 0 — that is, on or off — we can create a shape. This is illustrated by a grid diagram in figure 1.

The shaded blocks are 1s, the empty blocks are 0s and by using the decimal values of each byte as we did before we find that byte 0 = 36, byte 1 = 24, byte 2 = 60 and so on.

These decimal numbers will be used to create the character on the computer, but first decide which character the new one is to replace. If a little Invader character is to be displayed instead of the dollar sign, look up the character's number using the internal character set table on page 55 of the Atari Basic Reference Manual. The dollar sign is character 4. Since each character is eight bytes long, to find the offset from the start of our character set it is necessary to multiply the character number by eight.

This offset value is then added to the starting address of the character set and the decimal values obtained from the eight-by-eight square are then read into the next eight bytes beginning at that address. These lines of program should make it a little clearer:

```
60 FOR M=0 TO 7 : READ D :
   POKE N+M+(4*8),D : NEXT M
100 DATA 36,24,60,90,90,60,36,0
```

Line 100 holds the decimal values that we are using to create our character; line 60 places these values into our new character set, overwriting the dollar sign character.

The new character has now been placed in memory but it cannot be accessed yet, because the operating system has not been told to use the new character set, so it is continuing to use the original one in ROM. Memory location 756 contains the pointer for the character set and is automatically set to 224 on power-up, system Reset or a Graphics command.

Multiply 224 by 256; this obtains 57344, the location of the ROM character set. Now look back at line 40 of the program and you will find that P*256 gives the location of the character set. So, Poking 756 to P brings the brand-new custom character set into use. Now add the following line to the program or enter it as a direct command after the program has been Run.

```
70 POKE 756,P
```

Once the program has been Run, try using the dollar sign; all the other keys work normally. Try the program for Modes 1 and 2, but please note if you redefine lower case or graphics characters in these Modes, remember to add 2 to P. This is the same as using 226 instead of 224 when displaying lower case with the original character set. Try the following lines to change the letter D.

```
65 FOR M=0 TO 7 : READ D :
   POKE N+M+(36*8),D : NEXT M
110 DATA 24,24,24,60,126,255,153,153
```
■



CHARACTER DEFINITION

Space invaders may have more appeal then the Cyrillic alphabet but both are just as easily defined with Keith Robinson's program for the Atari 400/800.

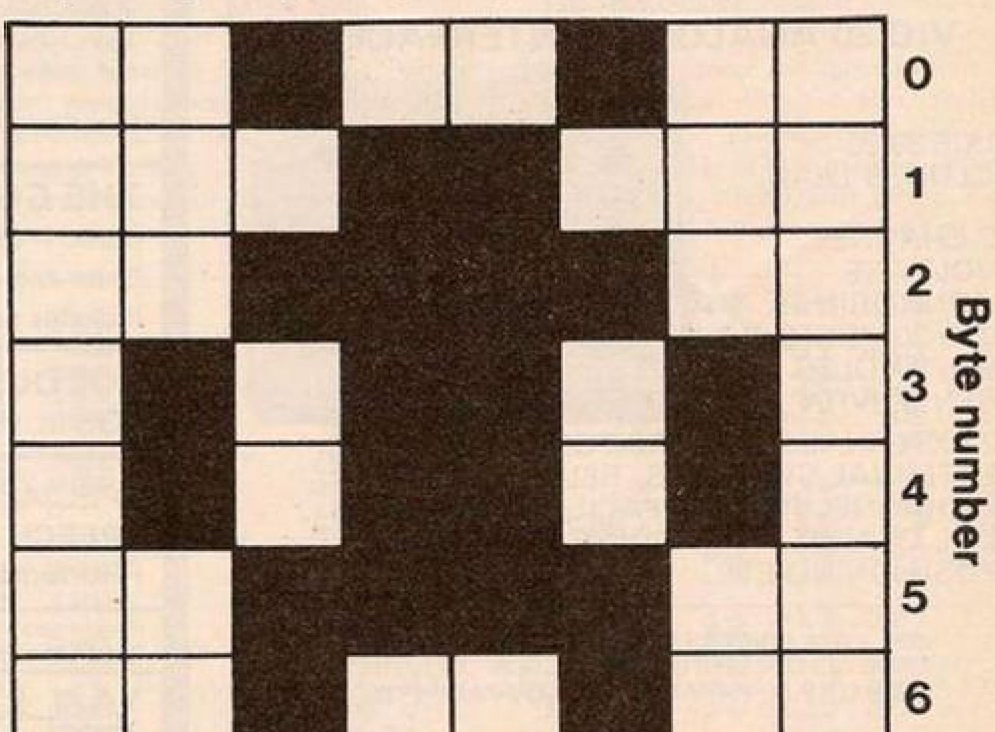


Figure 1.

1K CHESS

Last month David Horne showed you the board. This month he illustrates the move logic.

As a reminder, figure 1 depicts the playing board and figure 2 is the Basic program used to enter the machine code. This month we will start with the main driver. Enter Fast mode and change line 10 to read:

10 FOR A = 16681 or 16779

Run 10 and start entering the code shown in figure 3. The next routine to enter will be the keyboard controller, after typing Save "4". Change line 10 to read:

10 For A = 16860 to 16916

Run 10, start entering the code shown in figure 4 and then Save "5". Enter Slow mode and type Run — be prepared for a crash.

The machine is waiting for you to type either a W or B, and will respond by placing the appropriate symbol towards the top right of your screen. Try entering any letter you like first, to ensure that the code rejects all other inputs.

Now enter a number between 1 and 8, followed by a letter A to H at which point just about anything could have happened. The reason for the above exercise is to determine if the keyboard controller is working, that is, selecting which keys will be accepted as inputs.

At this point, it becomes very much more difficult to provide the reader with a comprehensive set of diagnostics. Suffice to say that we are breaking each party down into small routines, which can be re-entered one routine at a time in an effort to isolate the offending error.

Alternatively you may wish to try the program given in figure 7 of last month's article. Assuming after much murmuring, you appear to have this bit correctly entered, our next routine is the address converter. This takes the alphanumeric input and translates it to a board position. Change line 10 to read:

10 For A = 16801 to 16859

Run 10 and start entering the code shown in figure 5 and Save "6". The address converter has a little routine tacked on to the end which effectively checks to see whether the correct piece is being moved. So now enter Slow mode and Run the program. By the way, it will crash again. Enter your opening colour — B or W — then try spare spaces and the wrong colour positions to ensure that these entries are not acceptable. Now try a correct position, at which point the system will crash.

Finally, the move logic. This is going to be a bit of a marathon. You will be entering 170 numbers, around 15 minutes work. Change line 10 to read:

10 FOR A = 16917 to 17087

Run 10 and start entering the code shown in figure 6, and finally Save "7". Enter Slow mode, Delete lines 10 to 15, and Save "ZXCHESS", type Run and hope!

To help with error corrections look for the following: if the pawns do not move correctly, then look at the code from 17021 to 17087; problems with any other pieces, look at code 16981 to 17020. There is a piece selector from 16949 to 16980, if just one appears incorrect. The move tables are at 16926 to 16941, with a part of the pawn table at 16778 to 16780.

Now for a brief outline covering the important functions of the machine-code routines presented this month. We started at address 16681 with a call to a subroutine — 16860 — which tests for which key has been pressed, returning with a value in "a" which is compared with B(39) or W(60) to see who should start. Any other response will start the test for key depressed sequence again.

Dependent upon B or W being pressed, a black or white square is placed in the "whose move now" position located by routine DP1. The next routine at address 16701 overwrites the From and To data at the bottom of the board in preparation for the new data entry and is effectively the start of the move routine.

D. Horne. 1983.



Figure 1. The board.

```
 1■REM *** LOTS OF SPACES ***
 9 RAND USR 16570
10 FOR A=16514 TO 17087
11 INPUT B
12 POKE A,B
13 PRINT AT 1,0;A
15 NEXT A
```

Figure 2. Machine-code entry program.

```
                205 220  65 254  39
 40   7 254  60  32 245 175  24
16694
  2  62 128 205 144  65 119  62
  8 205 152  65 119  43 119 205
148  65 119  43 119  35 205 161
 65 254   3  32 234  34  60  64
175  50  62  64  89 205  46  66
16734
205 152  65 205 161  65 254   2
235  48 212  33  62  64  53 126
 60  40 204 133 111 126 185  32
242  42  60  64 126  54   0  18
205 156  64 205 144  65 126 198
16774
126 119  24 179  15  16
```

Figure 3. Main drives.

Continuing, we have a call to subroutine KT, the routine — 16801 — which accepts a number between 1 and 8 followed by a letter between A and H, puts them in the From position and transforms the pair of them to an address on the board by means of the address converter routine — 16806.

The board address is then tested to see whether the contents of the address is either the current mover's piece, an opposition piece, an empty square or part of the backcloth, and, depdenent upon which, "a" is set to a specific number. If it is not one of the current mover's pieces, it returns to the start of the move routine. If it is a current mover's piece, the From position is Saved and the number of legal moves for the position is set to zero.

The piece-move routine — 16942 — is called. This puts all the legal board positions that the From piece can move to into a table. The next data entry is also decoded by subroutine KT. providing a board position, and a status code of that position in "a". The "a" register is interrogated to see if the To

(continued on page 83)

Figure 4. Keyboard controller.

```
                            205 187
  2  62 255 169  40 248 186  40
245  68  77 205 189   7 126 201
213  66  75 197 205 220  65 193
185  40   6  12  16 245 209  24
16894
239 209 209 225 213 119  43 201
229  17  29   8 205 238  65 229
 17  38   8 205 238  65 201
```

Figure 5. Address converter.

```
            229 205   6  56 225
126 214  28  71  14  15 175 129
16814
 16 253 198  31  43  70 144 205
140  65  79   9 126 229 254 128
  6   1  40  23 254   0  40  19
  4 254   8  40  14   4 230 128
197 205 144  65  78 185 193  40
16854
  2   6   0 120 225 201
```

Figure 6. Move logic.

```
                             33
 62  64  52 126 133 111 113 201
  1  15 255 241 242 240  16  14
16934
 17 239  29 227 225  31 243  13
126 230 127 254  53  40  72  14
  1   6   8  33  38  66 254  51
 40  21  33  30  66 254  48  40
 14  72 254  54  40   9   6   4
16974
254  55  40   3  33  34  66 123
134 245 229 197 203 127  32  24
205 181  65 254   2  48  17 205
 21  66 254   0  40  10 193 225
121 254   1  40   5 241  24 224
17014
193 225 241  35  16 217 201 126
230 128  40   5  33  35  66  24
  3  33 140  65  22   3 123 134
229 245 203 127  32  24 205 181
 65 254   1  32  24 122 254   1
17054
 32  12 205  21  66 123 254  30
 56  19 254  90  48  15 241 225
 43  21  32 218 201 122 254   1
198  21  66  24 241 241 225  95
 24 205
```

D. Horne. 1983.

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(continued from page 81)

board position is empty or has an opposition piece present. If neither of these two is true the code returns to the start of move routines. If true, the board address is compared — 16745.

With each of the legal move positions tabulated by the From routine. Absence of a match restarts the routine again. A match leads on to the move routine — 16759 — which recalls the From position, gets its contents and replaces them with zero, the contents are then put in the 'To' position and routine B/W called. This rewrites all the black vacant squares and finally the "whose move now" square is changed followed by a jump back to the start-of-the-move routine.

The listing provides for a double move for pawns on their initial set-up ranks. The piece moves are controlled by the tables — 16926 — which are called — 16949 — to permit the appropriate movement associated with that piece. See figure 7.

Figure 7.

```
16681 CALL TKP         205 220 65
      CP N             254 39
      JP Z DIS         40  7
      CP N             254 60
      JP NZ DIS        32  245
      XOR A            175
      JP DIS           24  2
      LD A N           62  128
      CALL DPI         205 144 65
      LD (HL) A        119
16701 LD A N           62  8      (Move Routine)
      CALL DP5         205 152 65
      LD (HL) A        119
      DEC HL           43
      LD (HL) A        119
      CALL DP4         205 148 65
      LD (HL) A        119
      DEC HL           43
      LD (HL) A        119
      INC HL           35
      CALL KT          205 161 65
      CP N             254 3
      JP NZ DIS        32  234
      LD (NN) HL       34  60  64
      XOR A            175
      LD (NN) A        50  62  64
      LD E C           89
16731 CALL MOVE        205 46  66
      CALL DP5         205 152 65
      CALL KT          205 161 65
      CP N             254 2
      EX DE HL         235
      JP NC DIS        48  212
      LD HL NN         33  62  64
      DEC (HL)         53
      LD A (HL)        126
      INC A            60
      JP Z DIS         40  204
      ADD L            133
      LD L A           111
      LD A (HL)        126
      CP C             183
      JP NZ DIS        32  242
      LD HL (NN)       42  60  64
      LD A (HL)        126
      LD (HL) N        54  0
      LD (DE) A        18
      CALL B/W         205 156 64
      CALL DPI         205 144 65
      LD A (HL)        126
      ADD N            198 128
      LD (HL) A        119
      JP DIS           24  179
                       15  16
16801 PUSH HL          229        (KT)
      CALL KYBD        205 6   66
      POP HL           225
16806 LD A (HL)        126        (Address Converter)
      SUB N            214 28
      LD B A           71
      LD C N           14  15
      XOR A            175
      ADD A C          129
      DJNZ DIS         16  253
      ADD N            198 31
      DEC HL           43
      LD B (HL)        70
      SUB B            144
16821 CALL DPZ         205 140 65 (Test)
      LD C A           79
      ADD HL BC        9
      LD A (HL)        126
      PUSH H L         229
      CP N             254 128
      LD B N           6   1
      JP Z DIS         40  23
      CP N             254 0
      JP Z DIS         40  19
      NC B             4
      CP N             254 8
      JP Z DIS         40  14
      INC B            4
      AND N            230 128
      PUSH BC          197
      CALL DPI         205 144 65
      LD C (HL)        78
      CP C             185
      POP BC           193
      JP Z DIS         40  2
      LD B N           6   0
      LD A B           120
      POP HL           225
      RET              201
16860 CALL NN          205 187 2  (TKP)
      LD A N           62  255
      CP L             189
      JP Z DIS         40  248
      CP H             188
      JP Z DIS         40  245
      LD B H           68
      LD C L           77
      CALL NN          205 189 7
      LD A (HL)        126
      RET              201
16878 PUSH DE          213
      LD B D           66
      LD C E           75
      PUSH BC          197
      CALL NN          205 220 65
      POP BC           193
      CP C             185
      JP Z DIS         40  6
      INC C            12
      DJNZ DIS         16  245
      POP DE           209
      JP DIS           24  239
16895 POP DE           209
      POP DE           209
      POP HL           225
      PUSH DE          213
      LD (HL) A        119
      DEC HL           43
      RET              201

16902 PUSH HL          229        (KYBD)
      LD DE NN         17  29  8
      CALL NN          205 238 65
      PUSH HL          229
      LD DE NN         17  38  8
      CALL NN          205 238 65
      RET              201
16917 LD HL NN         33  62  64 (ADDLIST)
      INC (HL) .       52
      LD A (HL)        126
      ADD L            133
      LD L A           111
      LD (HL) C        113
      RET              201
16926 1 15 -1 -15 -14 -16 16 14
16934 17 -17 29 -29 -31 31 -13 13
16942 LD A (HL)        126        (Piece move)
      AND N            230 127
      CP N             254 53
      JP Z DIS         40  72
      LD C N           14  1
      LD B N           6   8
      LD HL NN         33  38  66
      CP N             254 51
      JP Z DIS         40  21
      LD HL NN         33  30  66
      CP N             254 48
      JP Z DIS         40  14
      LD C B           72
      CP N             254 54
      JP Z DIS         40  9
      LD B N           6   4
      CP N             254 55
      JP Z DIS         40  3
      LD HL NN         33  34  66
16981 LD A E           123        (Piece move routine)
      ADD A (HL)       134
      PUSH AF          245
      PUSH HL          229
      PUSH BC          197
      BIT 7A           203 127
      JP NZ DIS        32  24
      CALL NN          205 181 65
      CP N             254 2
      JP NC DIS        48  17
      CALL ADDLIST     205 21  66
      CP N             254 0
      JP Z DIS         40  10
      POP BC           193
      POP HL           225
      LD A C           121
      CP N             254 1
      JP Z DIS         40  5
      POP AF           241
      JR DIS           24  224
      POP BC           193
      POP HL           225
      POP AF           241
      INC HL           35
      DJNZ DIS         16  217
      RET              201
17021 LD A (HL)        126        (Pawn move routine)
      AND N            230 128
      JP Z DIS         40  5
      LD HL NN         33  35  66
      JR DIS           24  3
      LD HL NN         33  140 65
      LD D N           22  3
      LD A E           123
      ADD A (HL)       134
      PUSH HL          229
      PUSH AF          245
      BIT 7 A          203 127
      JP NZ DIS        32  24
      CALL NN          205 181 65
      CP N             254 1
      JP NZ DIS        32  24
      LD A D           122
      CP N             254 1
      JP NZ DIS        32  12
      CALL ADDLST      205 21  66
      LD A E           123
      CP N             254 30
      JP C DIS         56  19
      CP N             254 90
      JP NC DIS        48  15
      POP AF           241
      POP HL           225
      INC HL           43
      DEC D            21
      JP NZ DIS        32  218
      RET              201
      LD A D           122
      CP N             254 1
      CALL NZ ADDLST   196 21  66
      JR DIS           24  241
      POP AF           241
      POP HL           225
      LD E A           95
      JR DIS           24  205
```

D. Horne. 1983.

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MULTI-COLOUR VIC GRAPHICS

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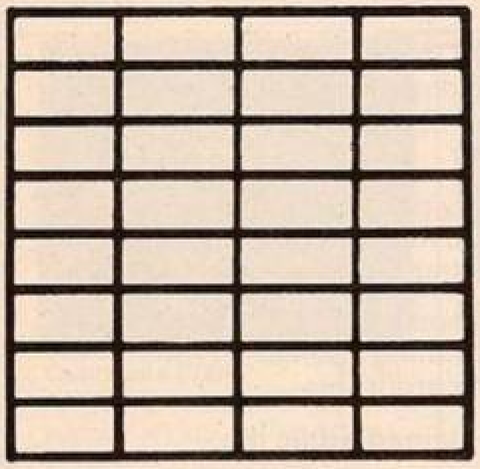


Figure 1.

MULTI-COLOUR GRAPHICS is a form of high-resolution graphics, and that is graphics defined on an eight by eight matrix of dots. However, it is different in that, unlike the high-resolution graphics which only have two colours for a dot on the matrix being lit or not lit, multi-colour characters have four colours.

There are a few limitations, in that the horizontal resolution is halved with multi-colour characters. That means that characters will be made on a four by eight matrix. Also, only four colours can be used; the border colour, the auxiliary colour, the character colour and the screen colour.

You cannot have many different characters with other colours because if you change the border, screen and auxiliary colours for a new character, the old character's colour will change. However, this may be used to produce special effects where many colours are changed very quickly.

To start defining a multi-colour character we must first decide on the colours. Since we can change the screen, border, character and auxiliary colours, we have a choice of four different colours which can be anything in the range of the Vic's first eight colours — except the border and auxiliary colours which may have 16 colours.

These colours are Poked into the Vic in the registers shown in table 1.

Poke	Comments
Poke 36879, screen and border colours	See Vic manual for combination of screen and border colours
Poke 36878, code of auxiliary colours (0-15) × 16	
Poke 646, code of character colour (0-7) + 8	Used to change the character colour for a PRINT statement.
Poke 30720 + address of point, code of character colour.	If you are poking onto the screen use this.

Table 1.

The codes of the character colours are found using the following table:—

0 Black
1 White
2 Red
3 Cyan
4 Purple
5 Green
6 Blue
7 Yellow

When the colours have been chosen and Poked into their appropriate memory location, you must start to design the character on a four by eight matrix. See Figure 1.

Once the colours have been put on the matrix where you want them, using, for example, A for auxiliary colour, B for border colour, C for character colour, you can set about coding the image. Each line of the matrix will become a binary number which will be put into memory in decimal. You must go through each of the eight lines of the character matrix to do this.

To convert the line to a binary number you must start at the left-hand side of the line and work your way to the right. If you come to a position where you want a screen colour, write down 00; for a place with a character colour, 10; for a place with a border colour, 01; and for a place with an auxiliary colour, write down 11. You should end up with an eight-digit binary number, for example 00011100. Repeat this for all eight lines on the matrix. When you have finished coding the design, convert all your number to decimal and put them into memory using the following routine:

```
DATA 8 decimal numbers.
FOR F= 7168 to 7175: READ A: POKE F, A:
NEXT
```

Now that it is in memory, we have to prevent it from being overwritten. Poke 52,28 is sufficient to do this. To use the character in memory you must change the value of 36869,255 to use the characters. You may have more than 1 character in memory. To do this add more data in the Data statement in the routine and increase the value of F, that is, increase 7175 in the previous routine. Here is an example program going through the steps required to generate a multicolour character.

First we choose the colours: white, black, red, blue and Poke them into memory.

```
10 POKE 36879,24     put white and black
                     into memory
20 POKE 36878,2×16   put red into memory
30 POKE 646,14       put blue into memory
```

Then we design the character, which will be a simple multicolour box, see figure 2. Now convert it to binary.

```
A A A A = 11111111
A C C A = 11101011
A C C A = 11101011
A C C A = 11101011
A C C A = 11101011
A C C A = 11101011
A C C A = 11101011
A A A A = 11111111
```

Then we convert the binary numbers to decimal:

```
11111111 = 255
11101011 = 235
11101011 = 235
11101011 = 235
11101011 = 235
11101011 = 235
11101011 = 235
11111111 = 255
```

Then we Poke them into memory.

```
40 DATA 255,235,235,235,235,235,235,255
50 for F= 7168 TO 7175: READ 1: POKE F,A:
NEXT
```

Next we must protect the character.

```
60 POKE 52,28
```

And last we must make use of the character and Print it:

```
70 POKE 36869,255: PRINT"(shift clr-home)@"
```

To prevent the screen being messed up by "Ready" appearing in multi-colour lettering the following line may be added:

```
80 GOTO 80
```

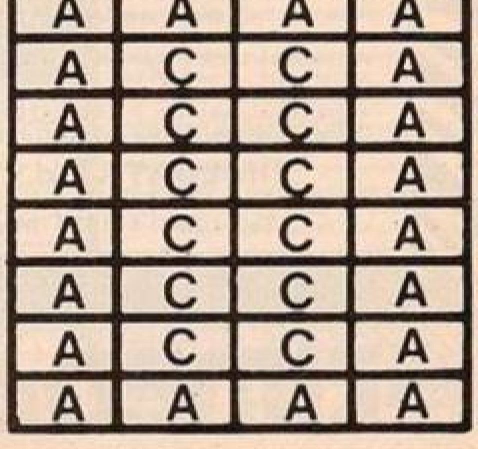
When the program is Run a multi-colour box will appear on the screen. You will be able to define your own character as easily as this.

To end with, here is a program to demonstrate what happens when one colour code is changed.

```
10 PRINT "(shift clr-home)"
20 DATA 0,10,10,42,42,130,142,142
30 DATA 0,160,160,168,168,130,142,142
40 DATA 170,170,170,170,170,170,170,160
50 DATA 170,170,170,170,170,170,170,130
70 FOR F = 7168 to 7199
80 READ A
90 POKE F,A
100 NEXT
110 FOR F = 7424 TO 7431: POKE F, PEEK
    (25600 + F): NEXT
120 POKE 36869,255: POKE 52,28
130 FOR F=1 TO 11
140 POKE 646,INT(RND(TI)×5)+10
150 PRINT "@A @A @A @A @A @A @A"
160 PRINT "BC BC BC BC BC BC BC"
170 NEXT
180 POKE 36878,(INT(RND(TI)×15)+1)×16
190 GOTO 180
```

■

Figure 2.



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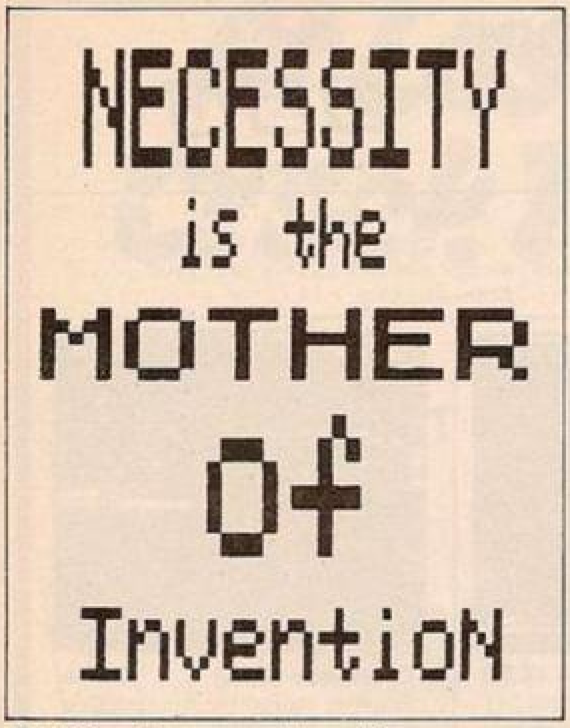
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THE FOLLOWING series of programs has been designed to compile a character set and machine-code routine enabling a ZX-81 to lineprint on a ZX Printer at 42 characters per line in place of the normal 32 characters. Other features include the option to expand to a maximum of 128 different characters — with no inverse, control of character height and width, and a self-edit lineprint at 42 characters per line, all at normal LPrint speed.

For convenience, the routine is compiled and saved in a dimensioned string array, being instantly copied into space automatically reserved above RAMtop whenever it is loaded into the computer. Although it is comprised of 1194 bytes, only some 125 need to be entered via the keyboard for the simplest version. It is left to the user to choose whether or not to expand its capabilities as described later.

The routine itself can be divided into three sections: first, the character set — 1024 bytes; second, LPrint — 118 bytes; third, Edit — 52 bytes.

Each of the 128 available characters is defined by eight 8-bit numbers, thus requiring 1024 bytes for the complete set. In order to print at 42 characters per line it is necessary to reduce character width effectively from 8 to 6 bits including spacing. Bits 7 to 2 are printed whilst bits 1 and 0 are ignored by the printer.

To avoid the tedious entry of a modified Sinclair set, one can use program 1 to do the job. This copies the character-defining codes from ROM and changes them accordingly. In effect, a chosen column of pixels — P — is removed from a character and the remaining columns to the right are shifted left by one column to close the gap created.

The graphics characters are not copied and remain as spaces. However, this gives the user an opportunity to design a new set of symbols to replace them and a character-generating program is suggested for this purpose. Consult page 78 of the ZX-81 manual for keyboard access to these characters, Codes 1 to 10.

I have also included space for a second character set which can be used, for example, to create space for a complete lower case set of alphabet characters as detailed in a later section. These characters replace the ZX-81 inverse Sinclair set and are accessed by the corresponding keyboard entries.

The LPrint section is a modified version of the ROM routine, and is compiled together with the Edit section using program 2. The modifications are as follows: first, point at the address of the new character set; second LPrint bits 7 to 2 only of the characters; third, 42-character lineprint, from a newly-located printer buffer; fourth control of character height and width.

As for the Edit section, Text to be LPrinted is compiled in Basic Rem statements, each one preceded by a call to the routine. The functions carried out are: (1) Locate the start of text via the NxtLine system variable. (2) Set the new printer buffer to an address above RAMtop (32512 to 32554) (3) Examine text in lines of 42 characters to ensure that no words overlap between successive lines. (4) Feed the edited lines to the new printer buffer. (5) Call the LPrint routine. (6) Return to the Basic control program when the end of the Rem statement has been reached.

When operating the compilation programs do remember to start with the command Goto. Do not use Run as this will cause the array holding the routine to be lost and overwritten.

First power-up the computer plus printer, Clear the memory and enter as a direct command Dim A$(1194). Having the dimensioned string array as first entry in the variables store is important because the machine-code program used to copy its contents above RAMtop assumes this to be the case.

Next enter program 1 and operate in Fast mode using Goto 10. The modified character set is completed in about 6.5 minutes. It is necessary to make further small amendments to the letters T, W and Y with the following direct commands:

```
LET A$(458) = CHR$ 124
LET A$(485) = CHR$ 84
LET A$(498) = CHR$ 68
```

Save the program at this and any intermediate stage as your confidence dictates.

Now key in program 2 and delete lines 150 and 160 of program 1. Be careful to enter the program exactly as listed. Operate using Goto 10. The program copies the LPrint routine from ROM, except where a prompt is made for you to enter a modification. Input the value given in the list provided for this section against the number of the array element printed on the TV screen. The LPrint section is complete at A$(1142), so entries made from A$(1143) onwards are for the Edit section. Be careful to double-check these entreis to avoid possible problems later.

Having now compiled the Deep Thought routine, you are in the position to write the short machine-code program used to copy it into memory reserved above RAMtop. It is not necessary to reset RAMtop as the program does this automatically. Enter program 3 and then delete lines 10 to 140 of program 2. Line 1 contains 21 characters, the addresses of which are used to hold the machine code instructions. Operate program 3 by mean of Goto 2 and enter the values as given in the list of entries for this program. When this stage has been completed line 1 should have taken on the appearance of line 1 shown in the listing of program 4. Retaining line 1, replace lines 2 to 6 with the corresponding lines of program 4.



This is the final program in its most elementary form. Save it, together with the array holding the assembled routine, using the command Goto 2. In this way, the machine-code routine in line 1 is executed immediately after the program has Saved. The letters OK should appear on the TV screen, printed by line 5 to indicate that the Deep Thought routine has been located in its new position above RAMtop, now set at address 31232. Print Peek 16389 should return a value of 122. Whenever program 4 is Loaded in future, the process will be repeated. If a message other than OK is printed on the screen check that line 5 is correctly entered. Otherwise re-check your entries for program 2. Two versions of the ZX-81 8K ROM exist, which differ here in the address of one LPrint subroutine. Line 6 can be included to ensure that the program will run on a ZX-81 other than the one used to compile it.

Once the final program is safely recorded on cassette, it can be tested with the aid of program 5, which demonstrates control of both height and width of characters and also 42-character lineprint. Having accomplished its task, you may first New the Basic program 4 before entering the test program. Note that the routine is called from the start of the Edit section — address 32374 — and that addresses 32266 and 32329 control character height and width respectively. The latter are initially set at unity for normal characters.

Text to be LPrinted is set up in Rem statements, any number of which may be employed, provided each one is preceded by a call to the routine. They may also be of any

TEXT

length within practical limits, Fast mode being recommended for ease of entry. The self-edit facility allows single spacing between all words.

When the test program is Run — there is no need to be restricted to Goto at this stage — you should see line 50 LPrinted in characters of increasing height and width, and line 90 repeated in characters of increasing height only. The number of characters allowed per line is obviously limited by character width — the edit feature only functions for normal characters — so wider-than-normal characters should be sent to the printer as single lines of suitable length. Extending such lines with enough spaces produces a striped effect which softens the tone of printing.

The maximum number of characters per line — N — is given by the expression N = INT(42/X), where X is the width-multiplying factor. I have used this to good effect in test program 6, which shows one way of extending automatic line edit to wider characters, controlled by the Basic program itself. A single character can be expanded to the full paper width — X = 42.

For those who wish to extend the character set, the character-generating program can be added to program 4. Characters can be designed on 8 by 8 graph paper grids, remembering that bits 7 to 2 only are printed and that bit 7 is set to zero to act as spacer. Simply convert the eight black and white pixels to 1 and 0 respectively to obtain the corresponding 8-bit binary number. This is entered as such directly into line 70 and then converted into the decimal equivalent in line 110. Note that a zero can be entered as a single "0".

Use Goto 10 in Fast mode when working with this program. It can be terminated after a character has been entered; mistakes can be rectified by entering Goto 20 and beginning the character again.

As stated previously, this method can be used for the unused graphics characters Codes 1 to 10, but a second set of characters can be built up between A$(523) and A$(1024). This could be used for lower-case letters, made equivalent to the respective inverse Sinclair upper-case letters. However, it is more convenient to have them in the position currently occupied by the modified upper-case letters between A$(305 TO 512), and the latter made equivalent to the inverse set, since in typewriter mode they are less frequently used. The true keyboard space must also be used between words for line Edit to function, so it is helpful to avoid overuse of the graphic mode at the keyboard.

Therefore, start by transferring a copy of the uper-case letters, which is quite easy within a string variable such as the one we are using. Just enter as a direct command:

LET A$(817 TO 1024) = A$(305 TO 512)

Change line 10 of the character generating program to:

10 FOR A = 38 TO 63

You are free to design your own set but to save time I have provided a list of decimal values as an example. Choosing this alternative requires the following further modification to the program to:

60 INPUT C (replaces LET C = 0)
Delete lines 70 to 120

The computer will prompt for the eight entries required for each character as given in the list provided. If you wish to fill up any of the remaining vacant spaces in the inverse set — not already occupied by the upper case set — the value for A in line 10 should lie between 64 and 101, namely 64 less than the Code for the character as shown in the ZX-81 manual. For example, the inverse space, Code 128, becomes Code 64 for the purposes of this program. When writing text for LPrint, upper case letters are then obtained from the keyboard via the corresponding inverse character and lower case letters, numbers and punctuations via the normal characters.

Try producing banner effects by creating characters rotated clockwise through 90 degrees. ■

Program 1.

```
  10 FOR A=11 TO 63
  20 LET P=4
  30 IF A<30 AND A<>15 OR A=35 O
R A=46 OR A=63 THEN LET P=6
  40 IF A=28 OR A=32 OR A=51 OR
A=54 THEN LET P=2
  50 FOR C=1 TO 8
  60 LET L=PEEK (7679+8*A+C)
  70 LET M=L
  80 IF A=17 OR A=57 OR A=62 THE
N GOTO 140
  90 FOR D=7 TO P STEP -1
 100 LET N=INT (L/2**D)
 110 LET L=L-N*2**D
 120 NEXT D
 130 LET L=L+M-N*2**P
 140 LET A$(8*A+C)=CHR$ L
 150 NEXT C
 160 NEXT A
```

Program 2.

```
  10 LET B=2173
  20 FOR A=1025 TO 1194
  30 IF A<1036 OR A>1076 AND A<1
119 OR A>1125 THEN GOTO 80
  40 IF B=2214 THEN LET B=2250
  50 LET C=PEEK B
  60 LET B=B+1
  70 GOTO 120
  80 SCROLL
  90 PRINT "A$(";A;") ";
 100 INPUT C
 110 PRINT C
 120 LET A$(A)=CHR$ C
 130 NEXT A
 140 LET A$(1073)=CHR$ 42
```

Entries for program 2.

A$	C	A$	C	A$	C
1025	33	1107	251	1155	0
1026	0	1108	16	1156	127
1027	127	1109	245	1157	1
1028	205	1110	193	1158	0
1029	231	1111	16	1159	43
1030	2	1112	235	1160	237
1031	229	1113	225	1161	160
1032	175	1114	24	1162	192
1033	95	1115	207	1163	40
1034	22	1116	219	1164	22
1035	1	1117	251	1165	16
1077	38	1118	31	1166	249
1078	30	1126	21	1167	18
1079	203	1127	32	1168	176
1080	20	1128	163	1169	6
1081	36	1129	28	1170	42
1082	135	1130	203	1171	190
1083	135	1131	91	1172	40
1084	203	1132	40	1173	10
1085	20	1133	156	1174	43
1086	131	1134	193	1175	27
1087	111	1135	62	1176	16
1088	126	1136	4	1177	249
1089	79	1137	211	1178	1
1090	6	1138	251	1179	42
1091	6	1139	205	1180	0
1092	122	1140	7	1181	9
1093	203	1141	2	1182	24
1094	1	1142	201	1183	4
1095	31	1143	42	1184	35
1096	197	1144	41	1185	62
1097	8	1145	64	1186	118
1098	1	1146	1	1187	18
1099	103	1147	5	1188	229
1100	219	1148	0	1189	205
1101	251	1149	9	1190	0
1102	31	1150	62	1191	126
1103	48	1151	118	1192	225
1104	251	1152	190	1193	24
1105	124	1153	200	1194	211
1106	211	1154	17		

ENTRIES FOR LOWER CASE SET

	1	2	3	4	5	6	7	8
38	0	0	112	8	120	72	116	0
39	0	64	64	88	100	100	88	0
40	0	0	56	64	84	64	56	0
41	0	4	4	52	76	76	52	0
42	0	0	56	68	120	64	60	0
43	0	8	20	16	124	16	16	0
44	0	0	56	68	68	60	4	60
45	0	64	64	88	100	68	68	0
46	0	16	0	16	16	16	56	0
47	0	8	0	8	8	8	72	48
48	0	64	72	80	96	80	72	0
49	0	48	16	16	16	16	56	0
50	0	0	124	84	84	84	84	0
51	0	0	88	100	68	68	68	0
52	0	0	56	68	68	68	56	0
53	0	0	88	100	100	88	64	64
54	0	0	52	76	76	52	4	4
55	0	0	88	100	64	64	64	0
56	0	0	56	64	48	8	112	0
57	0	16	16	124	16	20	8	0
58	0	0	68	68	68	68	56	0
59	0	0	68	68	68	40	16	0
60	0	0	84	84	84	84	40	0
61	0	0	68	40	16	40	68	0
62	0	0	68	68	68	60	4	56
63	0	0	124	8	16	32	124	0

Program 3.

```
  1 REM 123456789012345678901
  2 FOR A=16514 TO 16534
  3 INPUT B
  4 POKE A,B
  5 PRINT A;" ";B
  6 NEXT A
```

Entries for program 3.

16514	33	16521	64	16528	122
16515	5	16522	1	16529	1
16516	64	16523	6	16530	170
16517	54	16524	0	16531	4
16518	122	16525	9	16532	237
16519	42	16526	17	16533	176
16520	16	16527	0	16534	201

Program 4.

```
   1 REM 5▌RND@?E(RND"▗" ▄) ?"▙
GOSUB ▌TAN
   2 SAVE "DEEP THOUGH▌"
   3 RAND USR 16514
   4 LET A=32374
   5 PRINT CHR$ (PEEK A+10);CHR$
 PEEK (A-88)
   6 POKE 32271,PEEK 2177
```

Program 5.

```
   1 LET H=32266
   2 LET W=32329
  10 FOR A=1 TO 3
  20 POKE H,A
  30 POKE W,A
  40 RAND USR 32374
  50 REM YOUR  COMPUTER
  60 LPRINT
  70 POKE W,1
  80 RAND USR 32374
  90 REM THE TEXT PRINTED FROM T
HIS LINE WILL BE REPEATED WITH C
HARACTERS OF INCREASING HEIGHT O
NLY, EDITED AT 42 CHARACTERS PER
 LINE.
 100 LPRINT
 110 NEXT A
```

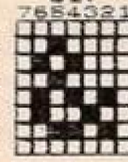
Program 6.

```
   1 LET A=32374
   2 LET H=32266
   3 LET W=32329
  10 FOR X=3 TO 6 STEP 3
  20 GOSUB 100
  30 IF X=3 THEN RAND USR A
  40 REM THIS IS A TEST RUN OF L
INE EDIT FOR LARGE PRINT
  50 IF X=6 THEN RAND USR A
  60 REM THIS IS A TEST PRINT
  70 RAND USR A
  80 REM ABCDEFGHIJKLMNOPQRSTUVW
XYZ
  90 NEXT X
  95 LET X=1
 100 POKE H,X
 110 POKE W,X
 120 LET N=INT (42/X)
 130 POKE 32390,N+1
 140 POKE 32401,N
 150 POKE 32410,N
 160 RETURN
```

Character-generating program entries for lowercase set Diagram.

```
  10 FOR A=1 TO 10
  20 CLS
  30 PRINT "CHARACTER CODE ";A
  40 FOR B=1 TO 8
  50 PRINT B;". ";
  60 LET C=0
  70 INPUT B$
  80 IF B$="0" THEN GOTO 130
  90 IF LEN B$<>8 THEN GOTO 70
 100 FOR D=1 TO 8
 110 LET C=C+VAL B$(D)*2**(8-D)
 120 NEXT D
 130 PRINT C
 140 LET A$(8*A+B)=CHR$ C
 150 NEXT B
 160 PRINT "PRESS N/L FOR NEXT C
HR. OR ENTER""S"" TO STOP"
 170 INPUT C$
 180 IF C$<>"S" THEN NEXT A
```

BIT
76543210



		BINARY		DECIMAL
1.	=	00000000	=	0
2.	=	00100000	=	32
3.	=	01010000	=	80
4.	=	00100000	=	32
5.	=	01010100	=	84
6.	=	01001000	=	72
7.	=	00110100	=	52
8.	=	00000000	=	0

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BASIC DICTIONARY

This dictionary, compiled by Tony Edwards, will explain the function of common Basic words as used in popular machines, enabling you to work out your own machine's equivalent. A useful complement to our recent series on Basic dialect translation.

BASIC DICTIO

IF. . .GOSUB A multiple branching statement which will jump to the named subroutine if the conditions following the IF are met.

IF. . .GOT Used in PDP-8E Basic as an abbreviation for IF. . .GOTO.

IF. . .GOTO A multiple branching statement which will jump to the line named if the conditions following the IF are met.

IF. . .LET A statement which assigns a value to a named variable if the conditions following the IF are met.

IF. . .T Used in TRS-80 Level 1 Basic as an abbreviation for IF . . . THEN.

IF. . .THE Used in PDP-8E Basic as an abbreviation for IF. . .THEN.

IF. . .THEN A conditional statement which is implemented only if the conditions following the IF are met. The statement following the THEN can be an assignment statement, or the address of a jump. Some computers allow operating statements such as END to follow the THEN, such as IF X = 0 THEN END. An ANSI standard statement.

IF. . .THEN. . .ELSE Some compilers allow one or more ELSE to follow the THEN statement. The statement following the ELSE will be processed only if the conditions following the IF are not met. This can be simulated by the use of nested IF. . .THEN statements — see *Your Computer* June 1982, page 44.

IN. Used in TRS-80 Level 1 and Palo Alto Tiny Basic as an abbreviation for INPUT.

IN# The command used by Apple II Basic to instruct the computer to address the peripheral designated by the argument.

**INKEY$** Used by TRS-80 Level II to input a character direct from the keyboard without the use of Enter. The program does not halt to await a key stroke and if no key is depressed, it returns an empty string — ASCII code 0. If the program is to be halted to await the key entry the INKEY$ must be embedded in a waiting loop. Similar to the GET statement.

INP This statement reads a decimal value from a port specified by the argument. An identical statement is used in PDP-8 Basic as an abbreviation for INPUT.

INPUT A universally-used statement which causes the computer to halt and await keyboard input usually outputting a ? prompt. The program will not continue until the Enter or Newline key is used. An ANSI standard statement.

INPUTL A statement similar to INPUT, but the carriage return is supressed.

INPUTLINE A BBC Basic statement, similat to INPUT, which uses a new line for each item input. The item is taken and assigned as is including commas, quotes and leading spaces.

INPUT # A BBC Basic statement which reads data in internal format from a file and assigns it to the variables specified as the argument.

INPUT # -x A statement which inputs a data unit from the port numbered x.

INSTR A function which returns the position of a sub-string within a string. If the substring is not found a 0 is returned, for example: X = INSTR (A$,B$) will return 2 if A$ = "T.EDWARDS" and B$ = "EDWARDS".

INT This function is used to round off numbers to their integer value. Numbers are always rounded down. Note that INT (−8.1) returns −9. *See also CINT.* A standard ANSI statement.

INVERSE This is an Apple II function which causes any text printed under it to be displayed as black letters on a white block.

L

L. Used as an abbreviation for the LIST command in a number of computers including Acorn, TRS-80 level 1, and Palo Alto Tiny Basic.

LE An alternative sometimes encountered for "less than or equal to".

LEFT A function used, sometimes with a $ appended, to isolate a specific number of characters starting at the left up to the number used for the second argument. The first argument being the string to be used. *See also RIGHT $ and MID $.*

LEN A function which will return the length of the string indicated as its argument.

LET The ANSI standard word to assign a value to a variable. For instance LET A = 10 would assign the value 10 to the variable named A. Some computers such as the ZX-81 require it, but in most cases it is optional. Some programmers use it optionally to flag the first use of a new variable.

LGT A function which calculates the common logarithm of its argument. The argument must be greater than 0. A common logarithm to the base 10.

LI Used as an abbreviation for LIST on TI-99/4 and other computers.

LIN A statement which causes a printer to skip the number of lines specified in the argument before printing the next line.

LIS The PDP-8E abbreviation for LIST.

LIST A command, also used as a statement, which causes each line of a resident programme to be printed in turn. Optional arguments cause only specific line numbers to be printed.

LLIST A command, or statement, used in some machines which operates like the LIST command but outputs to a printer.

LN A function which calculates the value of the natural logarithm of its argument. The argument must be greater than 0. A natural logarithm is the logarithm to the base e.

LOAD A command, which can be used as a statement, to cause a program to be loaded into memory from a storage medium.

LOG The ANSI standard word for the function to calculate the natural logarithm of its argument. An alternative to LN.

LOGE Another alternative to LN.

LOG 10 An alternative word with the same meaning as LGT.

LPPRINT A command and statement similar to PRINT — *see PRINT* — which causes the printout to appear on the printer.

LT An alternative used on some computers for "less than".

M

M. Used as an abbreviation for the MEM function in Microsoft Basic level 1. It can be a command function or statement.

MAN An unusual command from the Apple II set which allows manual insertion of program line numbers. Not used in programs.

MAT A prefix to a statement to indicate that a matrix is to be operated on by the next statement. For example, MAT INPUT will cause the processor to pause awaiting the inputting of a complete matrix. The matrix dimensions will have been previously assigned with a DIM statement. Other matrix statements are MAT PRINT and MAT READ.

MEM A command or statement which returns the number of bytes of memory remaining unused when it is called. An equivalent command to FREE (0).

MID $ A function which isolates a substring from within a previously defined string. The first argument is the target string or string name, the second argument is the start position, and the third argument the length of the substring. For example MID $("PRINT", 3, 2) would return "IN". Some compilers do not have the final $ character in the function. ■

DISASSEMBLIN
SPECTRUM RO

FOR PRACTICAL purposes, decoding the ZX-81 ROM gives the average user a list of symbols and numerals which provide a level of understanding little different from the original mass of numerical output. The resultant listings from the disassembler published in July's *Your Computer* unlock the power of the ROM, enabling machine-code programmers to use sections of code within their own programs. This should help you a little further along.

The value of a disassembler is significant only if you can use segments of the code within your own programs.

A further breakdown of the ROM routines is required to discover where each machine-code block begins. I have continued the theme of producing Basic equivalents to the machine code to preserve a degree of familiarity for those whose machine-code experience is limited.

From Address 3113 to 3143 is a list of pointers — table 1. Address 3113 is taken as the starting point and the contents of the address are added to the address to provide a pointer to another address. Figure 4 demonstrates this function provided by the Basic program in figure 3.

The result is an address which further points to the class of command being considered and the address of the machine code for that command in ROM. The commands start at code 225 — LPrint, which is defined in ROM as command 0 up to code 255 (copy), which is defined in ROM as command 30. Therefore if we follow LPrint through, we see that it is defined as command 0 and points to address 3113 + 139 = 3252.



Table 1.

```
          139  3113  ADC   A   E
          141  3114  ADC   A   L
H         45   3115  DEC   L
?         127  3116  LD    A   A
          129  3117  ADD   A   C
?         73   3118  LD    C   C
?         117  3119  LD    [illegible] L
?         25   3129  LD    E   A
RND       64   3121  LD    B   B
PI        66   3122  LD    B   D
F         43   3123  DEC   HL
*         23   3124  RIA
3         31   3125  RRA
R         55   3126  SCF
?         82   3127  LD    D   D
?         69   3128  LD    B   L
?         15   3129  RRCA
?         109  3130  LD    L   L
F         43   3131  DEC   HL
?         68   3132  LD    B   H
M         45   3133  DEC   L
?         90   3134  LD    E   D
V         59   3135  DEC   SP
?         76   3136  LD    C   H
?         69   3137  LD    B   L
$         13   3138  DEC   C
?         82   3139  LD    D   D
?         90   3140  LD    E   D
?         77   3141  LD    C   L
+         21   3142  DEC   D
?         106  3143  LD    L   D
          1    3144  LD    BC  532
=         20   3145
          2    3146
```

Table 2.

```
*         23   3350  RIA
9         37   3351  DEC   H
?         83   3352  LD    D   E
?         15   3353  RRCA
?         107  3354  LD    L   E
<         19   3355  INC   DE
?         118  3356  HALT
```

Figure 3.

PSN IN TABLE	ADDRESS	DISPLACEMENT	TABLE ADDRESS
0	3113	139	3252
1	3114	141	3255
2	3115	45	3160
3	3116	127	3243
4	3117	129	3246
5	3118	73	3191
6	3119	117	3236
7	3120	95	3215
8	3121	64	3185
9	3122	66	3188
10	3123	43	3166
11	3124	23	3147
12	3125	31	3156
13	3126	55	3181
14	3127	82	3209
15	3128	69	3197
16	3129	15	3144
17	3130	109	3239
18	3131	43	3174
19	3132	68	3200
20	3133	45	3178
21	3134	90	3224
22	3135	59	3194
23	3136	76	3212
24	3137	69	3206
25	3138	13	3151
26	3139	82	3221
27	3140	90	3230
28	3141	77	3218
29	3142	21	3163

```
  10 LPRINT " PSN IN        DISPLA
CEMENT  TABLE"
  20 LPRINT " TABLE  ADDRESS
      ADDRESS"
  25 LPRINT
  30 FOR A=0 TO 29
  40 LPRINT TAB 3;A;TAB 9;A+3113
;TAB 17;PEEK (A+3113);TAB 27;A+3
113+(PEEK (A+3113))
  50 NEXT A
  60 STOP
```

Figure 4.

PSN IN TABLE	ADDRESS	DISPLACEMENT	TABLE ADDRESS
0	3113	139	3252
1	3114	141	3255
2	3115	45	3160
3	3116	127	3243
4	3117	129	3246
5	3118	73	3191
6	3119	117	3236
7	3120	95	3215
8	3121	64	3185
9	3122	66	3188
10	3123	43	3166
11	3124	23	3147
12	3125	31	3156
13	3126	55	3181
14	3127	82	3209
15	3128	69	3197
16	3129	15	3144
17	3130	109	3239
18	3131	43	3174
19	3132	68	3200
20	3133	45	3178
21	3134	90	3224
22	3135	59	3194
23	3136	76	3212
24	3137	69	3206
25	3138	13	3151
26	3139	82	3221
27	3140	90	3230
28	3141	77	3218
29	3142	21	3163

Figure 1.

```
          6    3147  LD    B   0
          0    3148
          129  3149  ADD   A   C
          14   3150  LD    C   5
          5    3151
THEN      222  3152  SBC   A   5
          5    3153
          171  3154  XOR   L
          13   3155  DEC   C
          6    3156  LD    B   0
          0    3157
          181  3158  OR    L
          14   3159  LD    C   0
          0    3160
>=        220  3161  CALL  C   12
£         12   3162
          0    3163
          216  3164  RET   C
          14   3165  LD    C   4
          4    3166
          20   3167  INC   D
          6    3168  LD    B   223
TO        223  3169
          6    3170  LD    B   5
          5    3171
          185  3172  CP    C
          13   3173  DEC   C
          4    3174  INC   B
          0    3175  NOP
I         46   3176  LD    L   14
          14   3177
          5    3178  DEC   B
INT       207  3179  RST8
          10   3180  LD    A   BC
          1    3181  LD    BC  59648
          0    3182
DIM       233  3183
          14   3184  LD    C   5
          5    3185
          9    3186  ADD   HL  BC
          20   3187  INC   D
          5    3188  DEC   B
          106  3189  LD    L   D
          13   3190  DEC   C
          0    3191  NOP
?         195  3192  JP        771
          3    3193
          3    3194
          175  3195  XOR   A
          14   3196  LD    C   3
          3    3197
K         48   3198  JR    NC  7
          7    3199
          6    3200  LD    B   26
          26   3201
          6    3202  LD    B   0

          0    3203
          146  3204  SUB   D
          14   3205  LD    C   5
          5    3206
?         108  3207  LD    L   H
          14   3208  LD    C   5
          5    3209
RND       64   3210  LD    B   B
          3    3211  INC   BC
          5    3212  DEC   B
PLOT      246  3213  OR    2
          2    3214
          0    3215  NOP
?         124  3216  LD    A   H
          14   3217  LD    C   0
          0    3218
          154  3219  SBC   A   D
          20   3220  INC   D
          0    3221  NOP
E         42   3222  LD    HL  (1546)
          10   3223
          6    3224
          26   3225  LD    A   DE
          6    3226  LD    B   0
          0    3227
          175  3228  XOR   A
          11   3229  DEC   BC
          6    3230  LD    B   26
          26   3231
          6    3232  LD    B   0
          0    3233
          175  3234  XOR   A
          11   3235  DEC   BC
          0    3236  NOP
          14   3237  LD    C   12
          12   3238
          6    3239  LD    B   0
          0    3240
M         50   3241  LD    (15) A
?         15   3242
          0    3243
F         43   3244  DEC   HL
?         15   3245  RRCA
          0    3246  NOP
7         35   3247  INC   HL
?         15   3248  RRCA
          0    3249  NOP
?         105  3250  LD    L   C
          8    3251  EX    AF  AF
          5    3252  DEC   B
ACS       203  3253  [illegible]
          10   3254
          3    3255  INC   BC
C         44   3256  INC   L
          7    3257  RICA
CLEAR     253  3258  [illegible]
```

G THE
M

Okay, so you can decode your ROM. But where does it get you? In this article, David Horne looks at practical applications.



Figure 1 shows the contents; address 3252 and that which follows. The first address contents give the class of command; these are found in table 2 which commences with class 0 at address 3350. The class determines the attributes of the commands and also whether there should be a separator or not:

POKE A, B

A and B are attributes, the comma is the separator.

If the class is 0 or 5, then the next address contains the address of the routine in ROM. Otherwise further attributes or separators follow, until a class 0 or 5 is reached.

Figure 1 gives an initial breakdown of the first three parts of ROM command tables. You can decode the remainder if you wish; the same technique is used to unravel the class tables.

Where does this lead us? You can call the Basic class 0 commands from within your own machine-code programs.

201 105 8 Call 2153

will copy the screen to printer,

Call 3883 will set slow mode
Call 3875 will set fast mode

there are others; what can you do with them?

Figure 5 gives the Basic program for decoding this particular table and figure 6 the unravelled response.

As I said, the Basic programs are simplifications and really only pick out the essentials of the machine code. Figure 2 gives the ROM table decoder; if you followed the series on machine code, neglecting the RS32 and RS24, it should start to make sense.

The Spectrum tables are decoded in a similar manner, but in order not to fill the magazine with machine-code listings of the ROM, I have just presented the final decoded tables, figures 7 and 9, and the Basic programs for decoding the Spectrum ROM tables, figures 8 and 10.

Figure 2.

```
 TO        220  3294   RS24
           6    3295    LD    B    0
           0    3296
 RETURN
           254  3297    CP    118
?          118  3298
COS        200  3299   RET    Z
?          79   3300    LD    C    A
 SCROLL
           231  3301   RS32
?          121  3302    LD    A    C
CHR$       214  3303   SUB         225
 LPRINT
           225  3304
8          56   3305    JR    C    59
U          59   3306
?          79   3307    LD    C    A
5          33   3308    LD    HL   3113
D          41   3309
£          12   3310
           9    3311   ADD    HL   BC
?          78   3312    LD    C    (HL)
           9    3313   ADD    HL   BC
/          24   3314    JR         3
           3    3315
E          42   3316    LD    HL   (16432)

K          48   3317
RND        64   3318
?          126  3319    LD    A    (HL)
7          35   3320   INC    HL
6          34   3321    LD    (16432)  HL

K          48   3322
RND        64   3323
           1    3324    LD    BC   3316
 POKE      244  3325
£          12   3326
VAL        197  3327   PUSH   BC
?          79   3328    LD    C    A
 RETURN
           254  3329    CP    11
"          11   3330
K          48   3331    JR    NC   11
"          11   3332
5          33   3333    LD    HL   3350
-          22   3334
           13   3335
           6    3336    LD    B    0
           0    3337
           9    3338   ADD    HL   BC
?          78   3339    LD    C    (HL)
           9    3340   ADD    HL   BC
 FAST      229  3341   PUSH   HL
 TO        223  3342   RS24
TAN        201  3343   RET
 TO        223  3344   RS24
           185  3345    CP    C
4          32   3346    JR    NZ   16
>          16   3347
 SCROLL
           231  3348   RS32
TAN        201  3349   RET
```

Figure 9.

```
Class      Address
  0         7184
  1         7198
  2         7244
  3         7178
  4         7272
  5         7180
  6         7292
  7         7311
  8         7282
  9         7349
  10        7298
  11        7376
```

Figure 6.

```
 LPRINT     5           2763
LLIST       3           1836
STOP        0           3292
SLOW        0           3883
FAST        0           3875
NEW         0           963
SCROLL      0           3086
CONT        0           3708
DIM         5           5129
REM         5           3434
FOR         4     =
            6     TO
            5           3513
GOTO        6           3713
GOSUB       6           3765
INPUT       1           3817
LOAD        5           932
LIST        3           1840
LET         1     =
            6           3713
PAUSE       6           3890
NEXT        4           3630
 POKE       6     ,
            5           3730
PRINT       5           2767
PLOT        6     ,
            5           2991
RUN         3           3759
SAVE        5           756
RAND        3           3692
IF          6     THEN
            5           3499
CLS         0           2602
UNPLOT      6     ,
            5           2991
CLEAR       0           5274
RETURN      0           3800
COPY        0           2153
```

Figure 7.

```
Command      Class  Sep        Address

 DEF FN       5                 8032
 CAT          0                 6035
 FORMAT       10                6035
 MOVE         10    ,
              10                6035
 ERASE        10                6035
 OPEN #       6     ,
              10                5942
 CLOSE #      6                 5861
 MERGE        11         *
 VERIFY       11         *
 BEEP         8                 1016
 CIRCLE       9
              5                 8992
 INK          7          *
 PAPER        7          *
 FLASH        7          *
 BRIGHT       7          *
 INVERSE      7          *

 OVER         7          *
 OUT          8                 7802
 LPRINT       5                 8137
 LLIST        5                 6133
 STOP         0                 7406
 READ         5                 7661
 DATA         5                 7719
 RESTORE      3                 7746
 NEW          0                 4535
 BORDER       6                 8852
 CONTINUE     0                 7775
 DIM          5                 11266
 REM          5                 7090
 FOR          4     =
              6     TO
              6
              5                 7427
 GO TO        6                 7783
 GO SUB       6                 7917
 INPUT        5                 8329

 LOAD         11         *
 LIST         5                 6137
 LET          1                 573
 PAUSE        6                 7994
 NEXT         4                 7595
 POKE         8                 7808
 PRINT        5                 8141
 PLOT         9                 8924
 RUN          3                 7841
 SAVE         11         *
 RANDOMIZE    3                 7759
 IF           6     THEN
              5                 7408
 CLS          0                 3435
 DRAW         9
              5                 9090
 CLEAR        3                 7852
 RETURN       0                 7971
 COPY         0                 3756
```

Figure 8.

```
   1 FOR a=6728 TO 6777
   2 LET x=x+1: IF x>16 THEN COP
Y : CLS : LET x=0
   3 LET b=a-6522: PRINT CHR$ b;
TAB 12;
   4 LET c=a+PEEK a
   5 PRINT PEEK c,
   6 IF PEEK c=7 OR PEEK c=11 TH
EN PRINT TAB 21;"*": NEXT a
   7 IF PEEK c=9 OR PEEK c=8 OR
PEEK c=4 OR PEEK c=6 OR PEEK c=1
0 THEN GO TO 16
  10 PRINT TAB 24;PEEK (c+1)+256
*PEEK (c+2)
  13 NEXT a
  14 COPY
  15 STOP
  16 LET c=c+1
  17 IF PEEK c=0 THEN GO TO 10
  18 IF PEEK c=5 THEN PRINT TAB
12;: GO TO 5
  19 PRINT CHR$ PEEK c
  20 LET c=c+1: PRINT TAB 12;: G
O TO 5
  50 PRINT "Command    Class Sep
   Address"
  51 PRINT
  52 LET x=0
  53 GO TO 1
```

Figure 5.

```
  10 FOR A=3113 TO 3144
  20 LET B=A-2888
  30 PRINT CHR$ B;TAB 12;
  40 LET C=A+PEEK A
  50 PRINT PEEK C;
  60 IF PEEK C=1 OR PEEK C=6 OR
PEEK C=4 THEN GOTO 100
  80 PRINT TAB 24;PEEK (C+1)+256
*PEEK (C+2)
  85 NEXT A
 100 LET C=C+1
 110 IF PEEK C=0 OR PEEK C=5 THE
N GOTO 80
 120 PRINT TAB 16;CHR$ PEEK C
 130 LET C=C+1
 132 IF PEEK C=2 THEN LET C=C+1
 135 PRINT TAB 12;
 140 GOTO 50
```

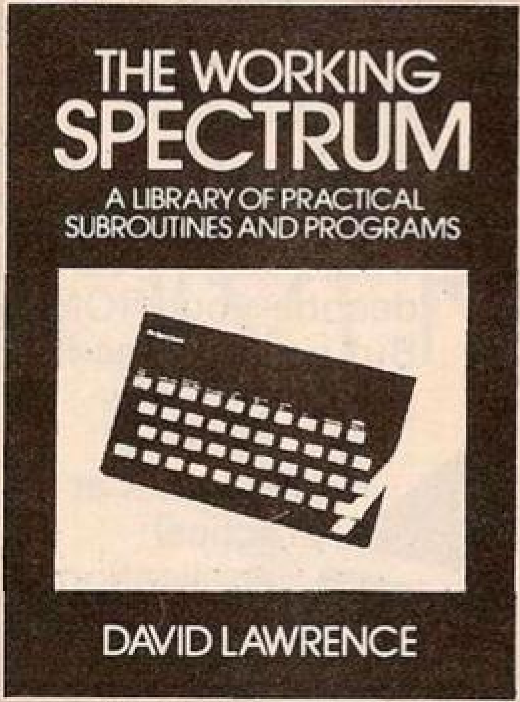
Figure 10.

```
  10 PRINT "Class     Address"
  20 FOR a=7169 TO 7180
  30 LET b=PEEK a
  40 LET c=7169+b
  50 PRINT "  ";A-7169;TAB 10;C
  60 NEXT A
  70 STOP
```

THE WORKING SPECTRUM

A LIBRARY OF PRACTICAL SUBROUTINES AND PROGRAMS

By David Lawrence



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CONTROL STAN FOR

The RS-232 and the Centronics interfaces are two standard computer communication methods. John Dawson puts your micro in touch with reality.

YOU MAY not be aware that there were several earlier electrical methods of sending messages that were largely superseded and made obsolete by the Morse code. These other methods were parallel channels of communication in that they required several wires. A piece of information was transmitted by setting each of the wires on or off at the same time. The first practical telegraph system was invented in 1837 by Sir Charles Wheatstone and W F Cooke and it was known as the Five Needle System. Five wires were required for signalling, and either the earth or a sixth to complete the circuit.

Clearly, systems that needed several wires to connect one station with another were no match for a serial method in which two wires could carry a message by sending the elements of a piece of information one after another. And so the Morse code triumphed. It was the universal standard means of long distance communication between humans for many years and is still used widely in both commercial and amateur radio transmission. Morse code allows two way communication between people who cannot speak the same language and has been used for the automatic transmission of data from devices such as weather balloons as well as the transmission of free text.

Another serial system was developed in 1874 and used for machine- to-machine communication. The Baudot code has five bits that make up each piece of information and telexes and teleprinters still send and receive information using an internationally-approved version of the 19th century Baudot code.

This article concerns two standard computer methods of communication. The first is a widely-used serial interface — the RS-232, which is slowly being upgraded to the RS-432. The second is the ubiquitous Centronics interface. Both are almost universal interfaces on hundreds of thousands of domestic and commercial computers.

```
PCHAR  PHP
       PHA
       STA   $BFE1
PCR1   LDA   $BFE0
       AND   #4
       BEQ   PCRZ
       LDA   $BFED
       AND   #2
       BEQ   PCR1
       PLA
       PLP
       RTS
PCRZ   LDX   #8      ; /// Printer error
       JMP   ERROR
V2POP  PHP
       PHA
       LDA   #0
       STA   $BFE3
       LDA   #$FF
       STA   $BFE3
       LDA   #$A
       STA   $BFEC
       LDA   #$7F
       STA   $BFEE
       LDA   $BFE0
       AND   #4
       BNE   V21
       LDX   #8      ; /// Printer error
       JMP   ERROR
V21    PLA
       PLP
       RTS
```

Figure 4. Program to set up a VIA.

Rather than confuse the issue by looking into the entrails of a complex micro, I intend to base a simple Centronics interface on the Microprofessor computer. The MPF-I computer is a good testbed for small programs of this sort and, like all computers, its value is increased greatly when it has the ability to produce hard copy by printing data and results on paper.

The ideas in this article apply to most microcomputers. The Acorn Atom has a VIA chip that can be used to acquire information from the real world by connecting analogue to digital converters or on/off switches to single bits, just as easily as it is used to drive a printer. If your micro does not have a Parallel Input/Output — PI/O — or Versatile Interface Adaptor — VIA — chip on the basic board it will almost certainly have a bus offering all the connections to the central processor unit — CPU — that you need to wire up a parallel port.

The Jupiter Ace falls into this class. Although the programs in this, and the subsequent article, will be in assembly language there is no reason why the few values that have to be set for either chip cannot be Poked into place with Basic. By doing this with the Oric, for example, you will be able to use the second timer for timing parts of games or to set up the machine as a frequency counter.

What is an interface? There are five elements of a complete interface specification for connections between two pieces of electronic equipment.

First, the mechanical connectors — the design of things like the diameter and shape of the pins and the plug retainers.

Second, the electrical design, the voltage levels on each pin, for example, and the permissible capacitance in the line.

Third, the functions of devices connected to the interface. The IEEE 488 interface classifies devices as "talkers", "listeners", or "controllers".

The fourth interface specification element concerns the communications protocol, which is an agreement that certain codes sent along the interface will be treated in the same way by all the devices that may be connected to the interface.

Fifth comes a higher level protocol which defines the use made of information by each machine. High-level protocols are necessary, for example, to route messages and ensure privacy.

Both the RS-232 interface and the Centronics parallel interface contain parts of both one and two in the list. Pin connections for versions of both interfaces are set out in figure 1. It is surprising that a "serial" interface should have almost as many connections as a parallel one, but the protocol for the RS-232 interface allows for a number of wired control functions as well as the transmission of data in both directions at once. Remember that the difference between serial and parallel is that information is transmitted down an RS-232 link one bit at a time, while the Centronics interface used in the Epson MX-80F/T and other printers carries eight bits at a time along the data bus — data 1 to 8. Many RS-232 connections can be made successfully using only four wires — a small selection from the total.

There are almost as many varieties of the RS-232 interface as there are equipment manufacturers. If a salesman ever offers you a "standard" RS-232 link, just make sure it works before you buy and do not expect to be able to connect the printer, or whatever peripheral device it is, to another machine without doing some rewiring.

You can set up a non-standard or standard serial link using the cassette port and your own software. I hope to do this in future, modelling the Computer Users' Tape System — CUTS — in software on the MPF-I and connecting this machine to an RML-380Z.

At present, though, I want to print out machine-code listings of fundamental subroutines to extend the MPF-I monitor capabilities. The basic MPF-I has a socket for a PI/O chip. The PI/O is a Zilog Z-80 range product that is matched by 6502 manufacturers with the 6522 Versatile Interface Adaptor. The main difference between the systems into which the chips fit is the memory-mapped approach taken by the 6502 as against the I/O port system used by the Z-80.

In the 6502 architecture, peripheral devices are treated simply as memory locations to which data can be sent and from which information can be read. The Z-80 uses the lower eight bits of the address bus to identify up to 255 ports for data I/O purposes. The 6502 CPU has no separate IORQ and MREQ lines.

Each PIO or PIA/VIA is essentially similar to any other. The purpose of the chip is to act as a multiport input/output device in which a port is simply a set of eight wires carrying a signal in parallel — an eight-wire needle system — Sir Charles would have been proud! In addition to the eight data bits the PI/O chip must have a way of agreeing with the peripheral device that a transfer of data has taken place. This is done by "handshaking", a process in which data is placed on the output of the PIO and one of the control lines is used as a strobe, which means that it can be made to

DARD INTERFACES MICROS

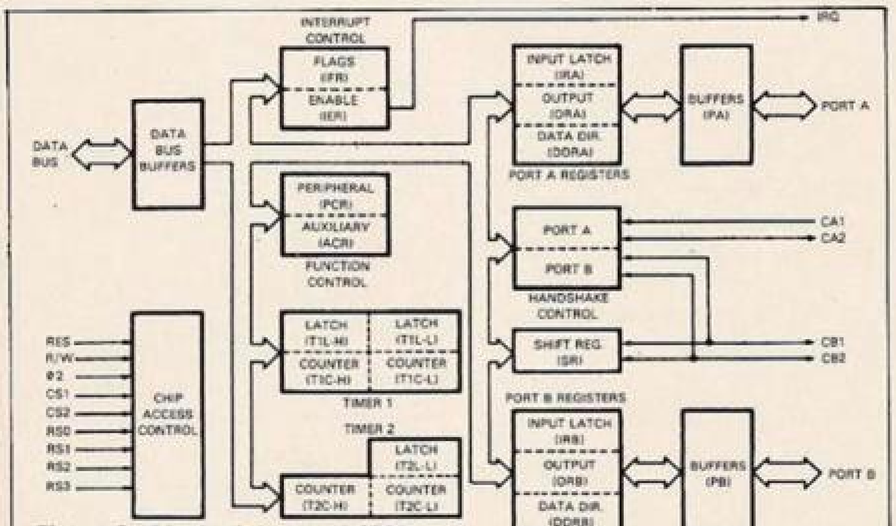


Figure 2. Block diagram of 6522.

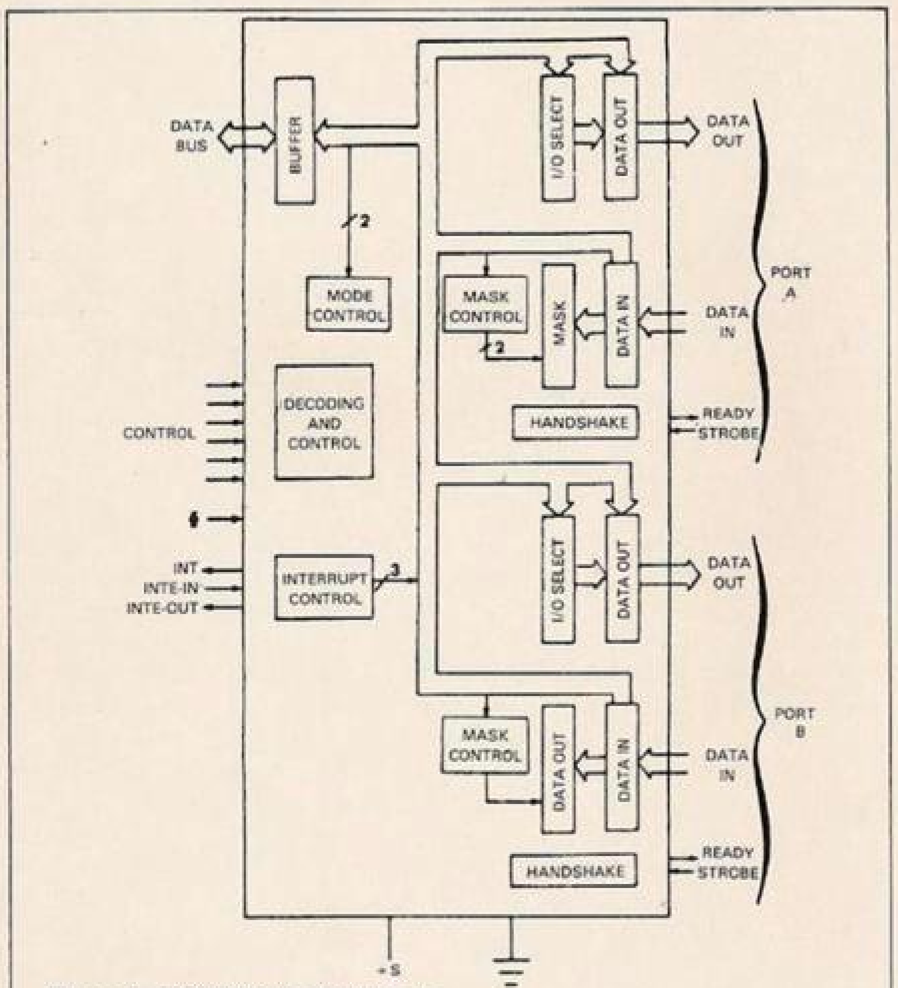


Figure 3. Z-80 PI/O block diagram.

Signal Pin	Return Pin	Signal	Direc-tion	Description
1	19	STROBE	In	Strobe pulse to read data in. Pulse width must be more than 0.5µs. at receiving terminal. The signal level is normally "High"; read-in of data is performed at the "Low" level of this signal.
2	20	DATA 1	In	These signals represent information of the first and eighth bits of parallel data respectively. Each signal is at "High" level when data is logical "1" and "Low" when logical "0".
3	21	DATA 2	In	
4	22	DATA 3	In	
5	23	DATA 4	In	
6	24	DATA 5	In	
7	25	DATA 6	In	
8	26	DATA 7	In	
9	27	DATA 8	In	
10	28	ACKNLG	Out	Around 5µs. pulse. "Low" indicates that data has been received and that the printer is ready to accept other data.
11	29	BUSY	Out	A "High" signal indicates that the printer cannot receive data. The signal becomes "High" in the following cases: 1. During data entry 2. During printing operation 3. In OFF-LINE state 4. During printer error status
12	30	PE	Out	A "High" signal indicates that the printer is out of paper.
13	—	SLCT	Out	This signal indicates that the printer is in the selected state.
14	—	AUTO FEED XT	In	With this signal being at "Low" level, the paper is automatically fed one line after printing. The signal level can be fixed to "Low" with DIP SW pin 2-3 provided on the control circuit board.
15	—	NC		Not used.
16	—	OV		Logic GND level.
17	—	CHASSIS-GND	—	Printer chassis GND. In the printer, the chassis GND and the logic GND are isolated from each other.
18	—	NC	—	Not used.
19 to 30	—	GND	—	Twisted-pair return signal GND level.
31	—	INIT	In	When the level of this signal becomes "Low", the printer controller is reset to its initial state and the print buffer is cleared. This signal is normally at "High" level, and its pulse width must be more than 50µs. at the receiving terminal.
32	—	ERROR	Out	The level of this signal becomes "Low" when the printer is in — 1. Paper End state. 2. Off-Line state. 3. Error state.
33	—	GND	—	Same as with pin numbers 19 to 30.
34	—	NC	—	Not used.
35	—	—	—	Pulled up to +5V through 4.7KΩ resistance.
36	—	SLCT IN	In	Data entry to the printer is possible only when the level of this signal is "Low". Internal fixing can be carried out with DIP SW 1-8. The condition at the time of shipment is set "Low" for this signal.

Figure 1. Centronics interface on MX-80.

output a pulse when the information on the data lines is stable and ready to be transferred to the receiving device.

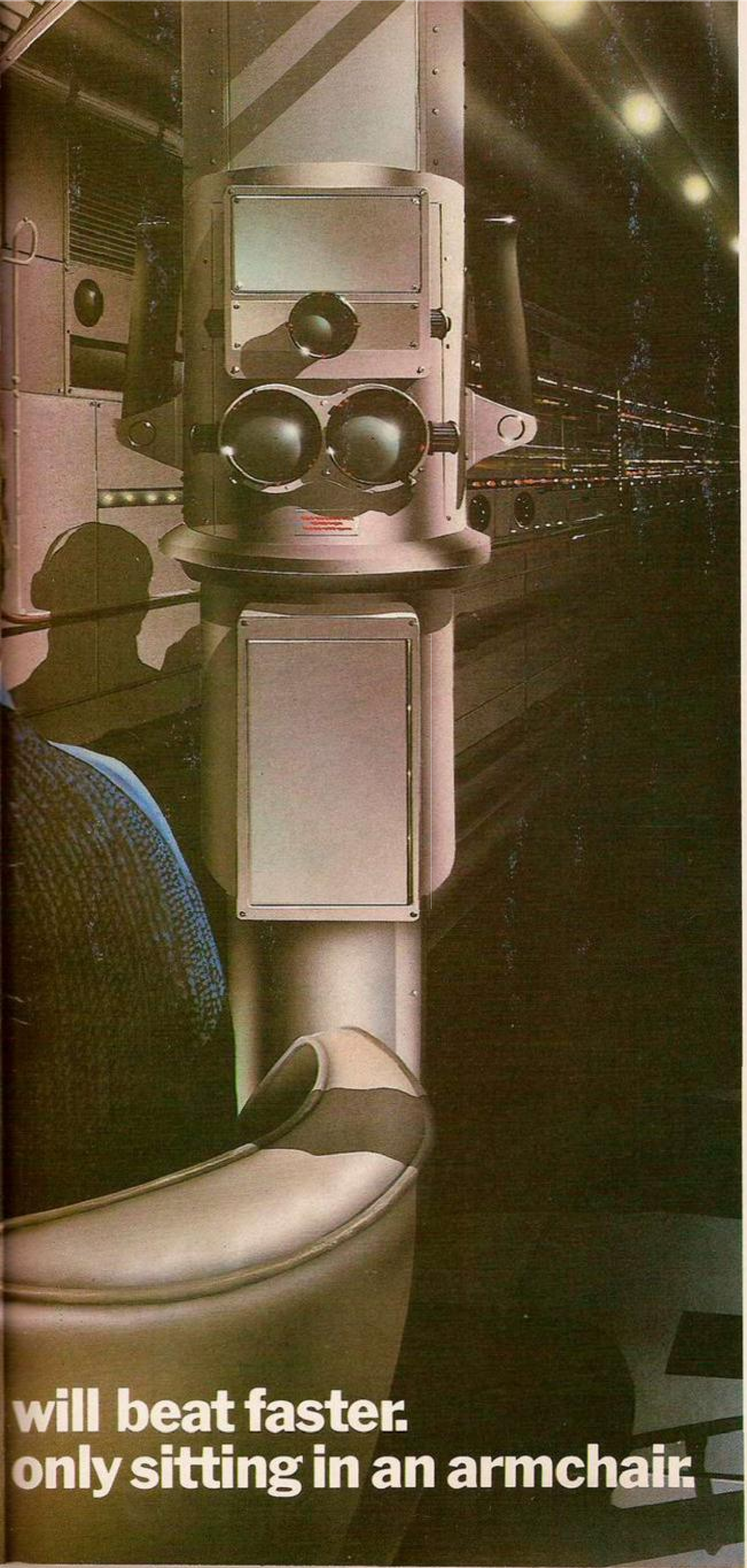
Following this the data is left on the output port until the receiving device sends a signal along the other control line for that port to say that it has the data safely on board.

Block diagrams for the two chips are set out in Figures 2 and 3. In addition to acting as two eight-bit latched I/O ports the 6522 also contains two very useful counter timers. On the Microprofessor computer board the hardware timers are provided by a counter timer circuit — CTC — chip.

A simple but adequate Centronics interface can be established using only the Data, Busy, Acknowledge, and Strobe lines — the Acorn Atom is an example and the Nascom 1 computer interface was even simpler, omitting to take account of the Acknowledge signal from the printer to say that the data had been received, and using the Busy signal alone.

Figure 4 illustrates a working program — V2POP — to set up a VIA on the Tangerine computer as a parallel output for a Centronics printer interface and another subroutine — PChar — which prints a character. The memory map values — $Bfe3 and so on — are specific to the Tangerine and will require alteration for your own system. ■


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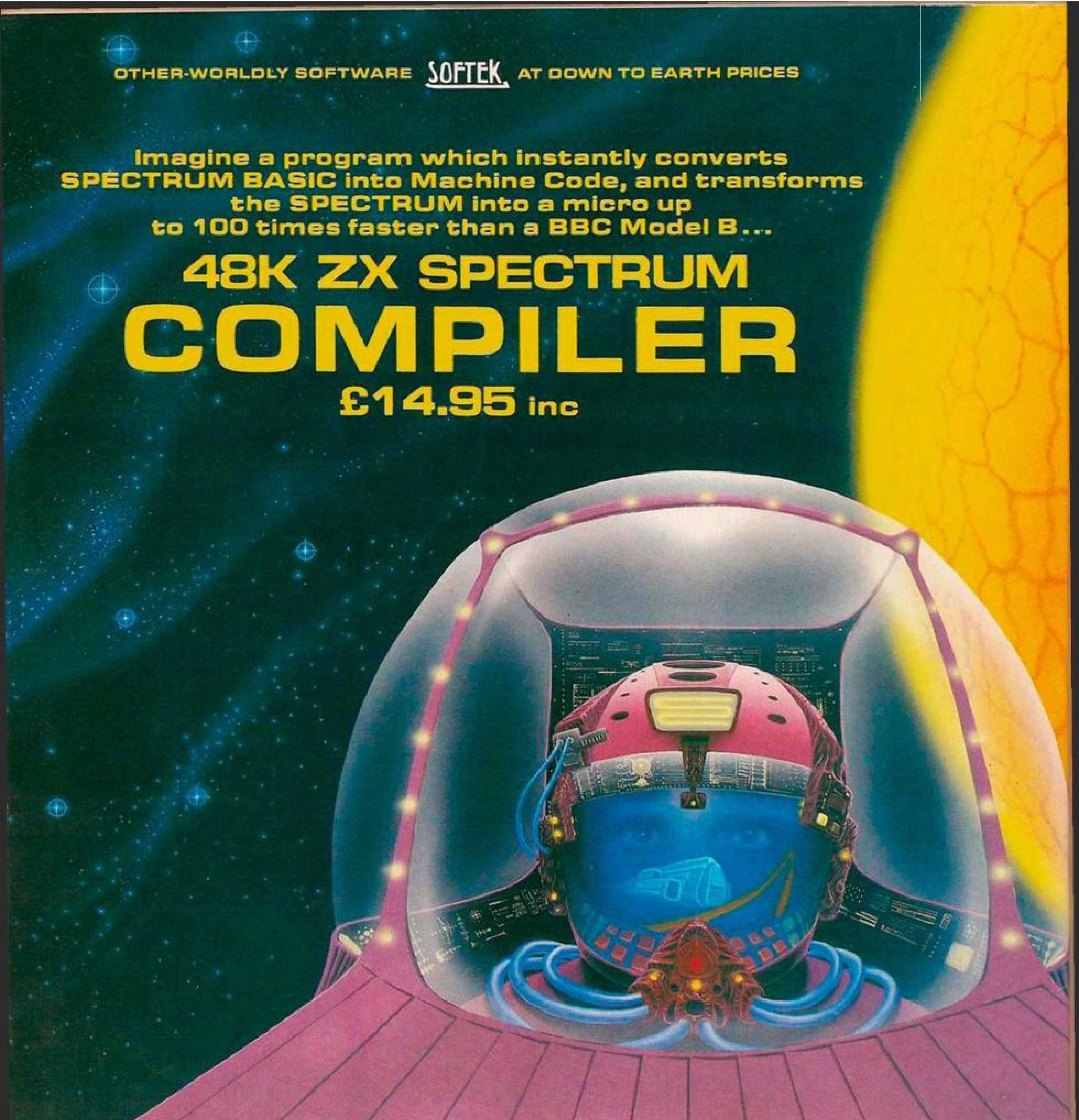
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BREAK-IN

I am a ZX-81 owner, and have a collection of software for my machine. A few of these programs consist entirely of machine code, which makes it impossible to break into the program. Can you suggest any way in which I can break into this kind of program so it can be saved on to another tape?

Bradd France,
Handsworth, Birmingham.

ONE OF THE reasons the tape cannot be broken into is to stop tape-copying. Copying a program to give to someone else is, in effect, stealing the program, and depriving the programmer and the manufacturer of the tape their rightful royalties. Even though routines do exist to break into machine-code tapes, it would be highly irresponsible for us to publish them.

ZERO SET

I have a Video Genie. I have found out that by using Goto a line number, rather than Run, I can execute a program over and over again from different points, but still have the variables in the program from a previous execution. However, by inserting or deleting lines, all variables are set to zero. Is there any way to get around this?

G Kowalczyk,
London N9.

UNFORTUNATELY, there is no simple way to get the variables to retain their value after an edit. When you change the length of the program, it could overwrite the variables store, so to avoid error, the Genie does a Clear every time Edit is used.

CAREER CHOICE

Our son, who will shortly be 13, is considering purchasing his first computer. He favours the ZX Spectrum. He will be taking Computer Studies at a later date at school, and is considering becoming a programmer.

In your opinion, would this be a good choice of computer for him?

Mrs Y Smith,
Tolleshunt D'Arcy,
Maldon.

THERE IS PROBABLY not a single computer on the market in the under £400 range which would not be worth getting. Even the ZX-81 can take a person a long way into the field of computing. The only real problem facing the Spectrum has been the long delivery delays. If you want a computer tomorrow, you can get most other models off the shelf. I suggest you work through the following checklist of questions before you make the final decision on which computer to buy. How much can I afford to pay? What are the three main things I will use the computer for? How much memory will I need for these? Which two or three computers fulfil the above requirements? Is there a store near me which sells and services these? How many of these computers have been sold? Are there letters in the magazines complaining of particular, persistent problems with the machines I am considering? Is there a range of suitable software available? How much does extra memory cost? Is Basic on-board, or will I need to "boot it up" with a plug-in cartridge or cassette? Are the machines under consideration supported by an active users' group? Do the machines under consideration save and load programs on to an ordinary cassette recorder, or would I have to buy a special recorder? If a special recorder is required, how much does it cost? Is the quality of the printer output of the computer good enough for my needs? If you work through these questions, you should find the choice of computer easy to make.

CUBEMASTER

I own a ZX Spectrum and have a problem. When trying to enter the Cubemaster program from the February, 1981 issue of *Your Computer*, written for a 16K ZX-81, I struck a serious problem. My 16K Spectrum decided to run out of memory at line 3050. I was particularly annoyed at this as it had taken about four hours solid programming to get this far. Why will this program fit in a 16K ZX-81, but not in my machine?

Simon Hillyer,
Naseby,
Northampton.

ALL COMPUTERS use up memory maintaining the display. About 1K is used on the ZX-81, but a massive 9K is used up for the high-resolution graphics on the Spectrum. Therefore, whereas you have, more or less, 15K to play with on a 16K ZX-81, you have only 7K on a Spectrum. Many other high-resolution computers — like the BBC Microcomputer — allow you to decide if you want the memory to be used for the display, or whether you will accept a lower screen resolution in return for more program memory. You do not have this option on the Spectrum. Although I doubt if you will squeeze Cubemaster into a 16K Spectrum, many other programs which are marked 16K ZX-81 are, in fact, far less than this, so you should be able to convert them for the Spectrum. If you are in doubt, leave out the instructions, and all Rem statements. You may well find you can put the instructions back in later, but I suggest you omit them the first time you try a ZX-81 program on the Spectrum.

NO LICENCE

I would like to know how the law stands on using a television with a computer. I have purchased a Sony 14 in. portable TV to use with my Spectrum. Do I have to pay £46 for a TV colour licence to watch my Spectrum?

Philip Graham,
Dallas Road, Lancaster.

THE LAW ON use of television sets only relates to their being used to receive broadcast signals. Although I not not believe the use of a television as a visual display unit for a computer has been tested in court, a recent decision was made in favour of a man who had been taken to court for watching video tapes on an unlicensed set. The court found in his favour, that is no licence was required if the set was not used to pick up broadcast signals.

GREEN SCREEN

I would like to know if a green screen monitor may be connected to a ZX-81. If it can, how do I do it? I would like a green, 9 in. or 12 in. monitor, preferably under £100. I have been looking at the Zenith monitor. Would this be suitable for the ZX-81? Do I need additional hardware?

J A Capless,
Mickleford, Leed.

YOU'LL FIND, of course, that a monitor will give better results than a domestic television. The Timedata *ZX-81 Magic Book* gives details of the hardware modifications needed to connect a monitor to a ZX-81. You may well find that you get a perfectly acceptable result without actually making the modifications.

NEAT FIGURES

I own a ZX-81. As you know, the computer prints from left to right, starting at the left-hand margin. This is fine for text, but produces very untidy-looking columns of figures. Could you please help me with a routine to produce neat rows of figures?

E Matos,
Sparkhill,
Birmingham.

THE EASIEST way to do this is to treat the number as a string, and from the length of the string, determine where across a line printing should begin. Run the following program, and you will see that no matter how large or small the number, the computer lines the numbers up correctly. Exit from the program by entering any letter except A.

```
10 INPUT A
20 LET A$=STR$ INT A
30 PRINT TAB 15-LEN A$;
40 IF A=.09999 THEN PRINT " ";
50 PRINT A
60 GOTO 10
```

HELP WITH FORTH WRITING

I own a Jupiter Ace, and am gradually getting to grips with Ace Forth. However, I was wondering if there was a simple way to remember which words are in the language on board, rather than having to constantly refer back to several different pages in the manual.

Ian King,
Pollokshields,
Glasgow.

THE FORTH command VList will cause the Ace to fill the screen with its words. It also makes an instant demonstration of the Ace, for when you feel frustrated and think you will never be able to master the language.

FULLER EXCUSE

I ordered a Fuller FD-42 keyboard for my ZX-81 at the Computer Fair on April 24, for which £37.50 was paid. Fuller Micro systems cashed the cheque on April 29, and sent me an acknowledgement on May 1, asking me to allow them 28 days delivery. After writing them many letters and finally informing them I was preparing to take them to the Small Claims Court the keyboard arrived on July 5. It was found to be faulty within an hour. The keyboard with a letter was returned to Fuller asking for a refund. The keyboard was sent back to me with no changes to my knowledge, as it still had the same fault. Please could you help me.

A R Weaver,
Swindon,
Wiltshire.

I SENT FULLER a copy of your letter, asking for comments, and the reply from Keith Archer did not explain the long delay in delivery, nor did he say why he did not refund your money when you asked for it. I am not sure what the law says, but I would think that as a courtesy if nothing else, a customer unhappy with a mail-order product should be able to return it in good condition and get his money back, no questions asked. Mr Archer believes the fault displayed by your keyboard — the 8, 1, K and M keys not working — is due to an RP-2 resistor pack missing from the ZX-81. He says he has offered to replace yours free if you send your ZX-81 to him, but this you have decided not to do. I suggest you show them this answer in the magazine, and request your money back again. If you do not get it, please write to us again.

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How can we Summarize in a short ad, an adventure game that needs a Special Program to detail it's Rules! Very, VERY simply, you must find the Map and Radio then plot your route and monitor patrols as they scoure the 40+ locations you are travelling through. If you have the right equipment you can cross into Secret territory in search of the Castle and the imprisoned Princess. If you manage to find it and gain entrance there are many trails and tests. If you manage to find the Princess you must still return to base with her. Utilises all the Spectrum's facilities and takes hours to play. **Only £5.95**

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EAST LONDON ROBOTICS—THE OPTIMUM SOLUTION

FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

LET ME BEGIN this month by reminding you that there is now a fully-fledged Hewlett-Packard users club in the United Kingdom. Membership entitles you to the bi-monthly publication of the society, *Datafile*, which is crammed with contributions from some of the current 130 UK members. I'm glad to say that sometime contributor to this column, Frank Wales, features prominently in the articles.

Subject matter tends to vary from analysis of new HP machines like the 15C and 75C, to full explanations of synthetic programming. As expected the HP-41C figures prominently in contributed programs and not all communications are as esoteric as "I am planning to properly document a program I have recently written to design or analyse storm sewers by the Wallingford Procedure Modified Rational Method." Anyone interested in this highly-recommended club should contact: PPC-UK, Astage, Rectory Lane, Windlesham, Surrey.

I used to recite poems about the Grand Old Duke of York to help me remember resistor colour coding — those days are now gone. Not only have I forsaken electronics but Stephen Godfrey of Hayling Island has written a conversion program for colours to resistance and vice-versa for the Sharp PC-1211. Stephen adds the following space-saving tip for the PC-1211; When entering lines which have the following format.

```
10 INPUT "INPUT VALUE OF
X:"; X
```

You can save several steps by reserving the keyword INPUT to a key, say Shift-M and then entering:

```
10 Shift-M "Shift-M of X:";X.
```

The computer then stores the word Input inside the quotes as one step which saves five as it includes a space at the end, too.

Nigel Gerdes of Dorset encloses a program which "takes the Casio FX-3500P to the limit of its programming ability!" He uses it in teaching students about communications networks, where the one sticky formula is inverse Cosh in the otherwise straightforward solution of networks. Continuing our efforts to provide useful "workhorse" programs, here is a Bessel function program for the TI-59 from L Weaver of Sussex.

Engineers and physicists who require Bessel functions for their work can often waste a great deal of time searching for sufficiently extensive tables. The attached short program for the TI-59 will calculate $J_r(x)$ to five figure accuracy for values of r between zero and 15, and x equal to or less than 6.

The basis is the recurrence relation $J_{n+1}(x)=(2n/x)J_n(x)-J_{n-1}(x)$. The trick is to realise that $J_n(x)$ tends to zero rather quickly as n increases. The program assumes that $J_{15}(x)$ and $J_{14}(x)$ are both zero, then starting from these trial values all other orders down to $J_0(x)$ can be calculated. These are individually stored.

However, these values are wrong by a factor which is calculable from the fact that $J_0(x)+2J_2(x)+2J_4(x)....=1$. This is also computed and divided into the original value.

To use, insert x and press A. After a few seconds the calculator stops with a value in the display which must be retained. Then insert r and press B, which will print out the required $J_r(x)$.

This program can easily be adapted to other calculators, or in fact to micros. A better accuracy can be obtained by starting with a higher original value of n than 15.

Finally we have a learning program from P Preece of Shropshire. Perhaps someone can develop the idea for more complex uses.

This program, designed for the Casio FX-180P, will test all four basic binary operations that is, addition, subtraction, multiplication, division and can suit people of different ages and help solve their difficulties in particular areas.

There is a round of questions which you have to answer. To get to the next round you must give the correct answer for a number of questions — preset by you — in a row. So getting the ninth question wrong, for example, resets your score to zero. This is best explained by the following diagram:

a) ROUND 1
X+X=
Get answer correct for Y times
in a row
ROUND 2
X+X+X=
etc.

b) SEQUENCE FOR LOADING
PROGRAM
MODE O
INV PCL Clear
INV KAC all
INV MIN memories

Press the AC key, tap the value of u then press the P1/P2 key (the program should have been loaded in P1 store). At the first Ent display tap the value of v and then the run key. At the second Ent, display the value of u, and at the third and last the value of v. Press the Run key to continue as before.

The first displayed result will be the value of v. When ready press the Run key and the final result will be the value of V.

Note. Make sure the calculator is in Mode 5 (ie radians) for the correct results. (continued on next page)

```
5 PAUSE "***RESISTOR CONVERTOR***"
10 CLEAR :N$="SILVER":O$="GOLD":P$="BLACK":Q$="BROWN":R$="RED":S$="ORANGE"
20 T$="YELLOW":U$="GREEN":V$="BLUE":W$="VIOLET":X$="GREY":Y$="WHITE"
25 K=1E3:M=1E6
30 PAUSE "YOU MAY FIND:":PAUSE "1 - VALUES FROM COLOURS"
40 PAUSE "2 - COLOURS FROM VALUES":PAUSE "3 - END
45 INPUT "INPUT OPTION:":A$:GOTO 50
46 BEEP 1:GOTO 30
50 IF A$="1"THEN 80
60 IF A$="2"THEN 220
62 IF A$="3"END
65 BEEP 1:GOTO 30
80 INPUT "FIRST COLOUR:":B$
90 INPUT "SECOND COLOUR:":C$
100 INPUT "THIRD COLOUR:":D$
110 FOR L=2TO 4
120 FOR J=14TO 25
130 IF A$(L)=A$(J)LET A(L+3)=J-16:GOTO160
140 NEXT J
150 BEEP 1:PAUSE A$(L):" IS INVALID.":INPUT "PLEASE RE-INPUT ":A$(L):GOTO 120
160 NEXT L
170 IF (E<0)+(F<0)PAUSE "INVALID DATA":GOTO 80
180 IF H<KLET I$="":GOTO 210
190 IF H<MLET I$="K":H=H/K:GOTO 210
200 H=H/M:I$="M"
210 PRINT H:"  ":I$:" OHMS."
215 GOTO 45
220 INPUT"VALUE:":H:IF (H>=0.1)+(H<=9.9E10)THEN 230
225 BEEP 1:PAUSE"INVALID":GOTO 220
230 FOR J=10TO -1STEP -1
240 IFH>= 10^JLET H=H/10^J:GOTO 270
250 NEXT J
270 D$=A$(J+15)
280 C$=A$((H-INT H)*10+16)
290 B$=A$(INT H+16)
300 PRINT B$:"  ":C$:"  ":D$
310 GOTO 45


PLEASE NOTE: VALUES MAY BE ENTERED IN THE FOLLOWING FORMS:

2200 OHMS CAN BE ENTERED AS a) 2200  or b) 2.2K  BUT NOT 2K2.

4700000 OHMS CAN BE ENTERED AS a) 4700000  or b) 4.7M  BUT NOT 4M7.

THE RANGE OF VALUES IS (WHERE V IS VALUE):  0.1<=V<=99000 MEG OHMS.
```

Resistor converter for Sharp PC-1211 by S Godfrey.

Calculation of inverse Cosh of a complex number.

Let U ± jV = inv cosh (u ± jv)

$$U = \cosh^{-1}\left\{\frac{\sqrt{(1+u)^2+v^2}+\sqrt{(1-u)^2+v^2}}{2}\right\}$$

$$\pm jV = \pm j\cos^{-1}\left\{\frac{\sqrt{(1+u)^2+v^2}-\sqrt{(1-u)^2+v^2}}{2}\right\}$$

Press AC, tap value of u. Press P1/P2 — having loaded program in P1 store. At first ENT display, tap value of v and Run. At second ENT, display the value of u. At final ENT, display the value of v. Press Run to continue as before.

	10. Kin 1	20. =	30. INV HLT
1. +	11. ENT	21. INV √	31. Kout 1
2. 1	12. +/−	22. Kin 2	32. −
3. =	13. +	23. +	33. Kout 2
4. INV x²	14. 1	24. Kout 1	34. =
5. +	15. =	25. =	35. /
6. ENT	16. INV x²	26. /	36. 2
7. INV x²	17. +	27. 2	37. =
8. =	18. ENT	28. =	38. INV COS
9. INV √	19. INV x²	29. INV HYP COS	

L Weaver's Bessel functions program.

```
000   76  LBL
001   11   A
002   42  STO
003   25   25
004   00   0
005   32  X:T
006   01   1
007   05   5
008   42  STO
009   23   23
010   01   1
011   04   4
012   42  STO
013   22   22
014   01   1
015   03   3
016   42  STO
017   21   21
018   01   1
019   42  STO
020   14   14
021   65   ×
022   02   2
023   08   8
024   55   ÷
025   43  RCL
026   25   25
027   54   )
028   42  STO
029   13   13
030   01   1
031   94  +/-
032   44  SUM
033   23   23
034   44  SUM
035   22   22
036   44  SUM
037   21   21
038   73  RC*
039   22   22
040   65   ×
041   02   2
042   65   ×
043   43  RCL
044   22   22
045   55   ÷
046   43  RCL
047   25   25
048   54   )
049   75   -
050   73  RC*
051   23   23
052   54   )
053   72  ST*
054   21   21
055   43  RCL
056   21   21
057   67   EQ
058   79   x̄
059   61  GTO
060   00   00
061   30   30
062   76  LBL
063   79   x̄
064   43  RCL
065   00   00
066   42  STO
067   26   26
068   43  RCL
069   14   14
070   85   +
071   43  RCL
072   12   12
073   85   +
074   43  RCL
075   10   10
076   85   +
077   43  RCL
078   08   08
079   85   +
080   43  RCL
081   06   06
082   85   +
083   43  RCL
084   04   04
085   85   +
086   43  RCL
087   02   02
088   54   )
089   65   ×
090   02   2
091   54   )
092   44  SUM
093   26   26
094   92  RTN
095   76  LBL
096   12   B
097   42  STO
098   27   27
099   04   4
100   04   4
101   69  OP
102   04   04
103   43  RCL
104   25   25
105   69  OP
106   06   06
107   00   0
108   01   1
109   03   3
110   05   5
111   01   1
112   06   6
113   03   3
114   05   5
115   69  OP
116   04   04
117   43  RCL
118   27   27
119   69  OP
120   06   06
121   73  RC*
122   27   27
123   55   ÷
124   43  RCL
125   26   26
126   54   )
127   99  PRT
128   92  RTN
129   00   0
130   00   0
131   00   0
132   00   0
133   00   0
134   00   0
```

```
EXAMPLE RUN
PRESS P1
'DISPLAY" DEG
        5
PRESS RUN
'DISPLAY" DEG
        6
PRESS RUN
         RAD
        2
ENTER ANSWER
IF YOU MADE A MISTAKE
PRESS C AND RE-ENTER.
PRESS RUN

DISPLAY NOTES:

DEG Indicates your previous answer was correct
GRA Indicates your previous answer was incorrect
RAD Indicates that your score is in the display
```

Step	Program	Comments
1	P1	Select Program Number
2	MODE 70	
3	INV RAN	Generate random number
4	INV X>K1	
5	Kin X1	
6	INV X≡K1	
7	INV RND	
8	INV HLT	Stop and display number
9	+, −, ×, ÷	Designate type of operations
10	Kin 5	Store pending result
11	1	Reduce counter by 1 and check if O. If C>O go to step 2 IF C3O continue
12	Kin −2	
13	Kout 2	
14	INV X>O	
15	1	
16	=	Finish off calculation so as not to affect the next one.
17	Kout 3	Reset counter
18	INV X>K2	
19	INV X>K4	Bring score into display register and store in K6 and clear K4 register
20	Kin 6	
21	MODE 5	
22	ENT	Stop to allow user to enter answer. Subtract user answer from calculator total If O continue If not go to step 2.
23	Kin −5	
24	Kout 5	
25	MODE 6	
26	INV X>O	
27	+/−	
28	INV X>O	
29	MODE 4	
30	1	Add 1 to score, if it is less than or equal to memory register go to step 2 if not continue.
31	Kin +6	
32	Kout 6	
33	Kin 4	
34	INV X M	
35	Kin −4	
36	1	Add 1 to counter for next round
37	Kin +2	
38	Kin +3	
39	INV RTN	
	MODE ●	

Memories

K1 Maximum number to be displayed by calculator
K2 2 K4 0 K6 0
K3 2 K5 0
M = Number of questions to get right.

P Preece's Casio education program.

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Worry maze

Andrew Spencer,
Cape Town,
South Africa.

ZX-81

THE FAST GAME in which the player weaves through a maze to defuse bombs is not only an exciting game, but shows the speed of Poke instead of Print At. It also illustrates a few handy techniques.

The first of these is the use of Boolean algebra to make the decisions in lines 140 and 450. These do away with If-Then lines and thus increase speed.

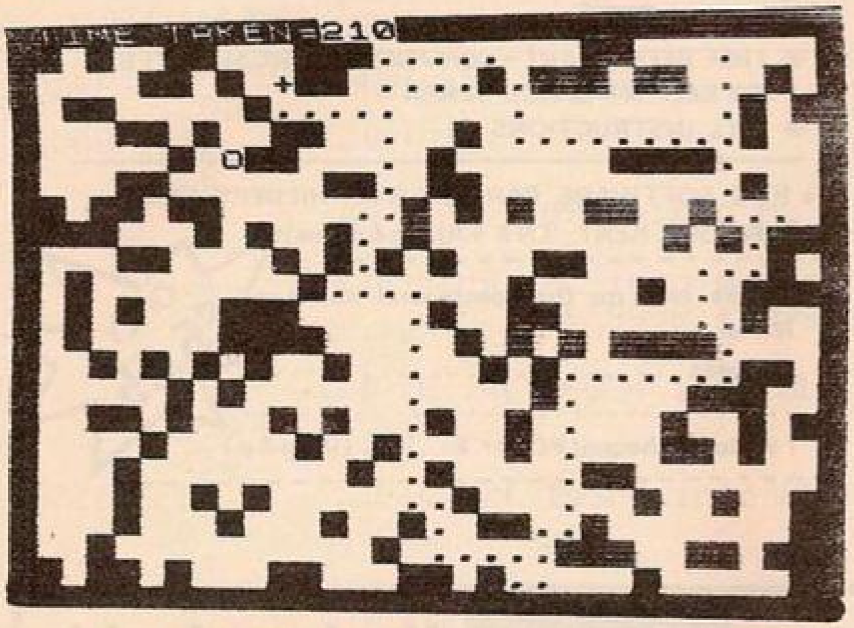
The internal walls of the maze are positioned in lines 230 to 260. The whole screen is used — line 150 — and thus the wall positions must be put within the boundaries. The same goes for the bombs and the player's piece — lines 280 and 330. Lines 290 and 340 check for boxing in of a piece or two pieces in the same place. B$ tells if the bomb arrived at is the correct one. One character in B$ is the bomb and if you reach a dud bomb it is represented by a D.

If you take too long to find the correct bomb you will explode — line 730. The full set of single-space characters is cycled through, alternating between inverse and normal.

A record is kept of the lowest time taken, and this is displayed at the end of each successful game.

The recruit mode allows you to backtrack but if you are not careful you can box yourself in on the "veteran" mode. If this does happen, pressing E will immediately put you out of your misery.

The direction-controlling keys can be changed, if desired, to suit your fingers: lines 450 and 90.




```
  10 REM ██ MAZE OF WORRY ██
            BY A.N. SPENCER ██
         ██ AUGUST 1982
  20 LET DF=PEEK 16396+256*PEEK
16397
  30 LET LSF=1000
  40 DIM B$(5)
  50 LET T=0
  60 CLS
  70 REM ██ INSTRUCTIONS ██
  80 PRINT "WELCOME........",,,,
"   TO THE MAZE OF WORRY"
  90 PRINT AT 4,0;"MOVE YOUR PIE
CE AROUND BY USING THE ""Z"", ""
C"", "".""  AND ""P"" KEYS"
 100 PRINT ,,"YOU MUST TRY TO DE
FUSE THE     CORRECT BOMB BEFOR
E IT BLOWS UP"
 110 PRINT ,,"    YOU ARE A :",,,
,"1: RECRUIT BOMB DISPOSAL OFFIC
ER",,,,"2: VETERAN BOMB DISPOSAL
 OFFICER"
 120 LET A$=INKEY$
 130 IF A$<>"1" AND A$<>"2" THEN
 GOTO 120
 140 LET TRAIL=27*(A$="1")+128*(
A$="2")
 150 POKE 16418,0
 160 FAST
 170 REM ██ PRINT THE MAZE ██
 180 PRINT AT 0,0;"████████████████
████████████████"
 190 FOR N=1 TO 22
 200 PRINT "█                              █"
 210 NEXT N
 220 PRINT "████████████████████████
████████"
 230 FOR N=1 TO 225
 240 LET BLOCK=DF+INT (RND*22)*3
3+INT (RND*30)+35
 250 POKE BLOCK,128
 260 NEXT N
 270 REM ██ PLAYER POSITION ██
 280 LET GP=DF+INT (RND*22)*33+I
NT (RND*30)+35
 290 IF PEEK (GP-33)=128 AND PEE
K (GP+33)=128 AND PEEK (GP-1)=12
8 AND PEEK (GP+1)=128 THEN GOTO
280
 300 POKE GP,21
 310 REM ██ BOMB POSITIONS ██
 320 FOR N=1 TO 5
 330 LET BP=DF+INT (RND*22)*33+I
NT (RND*30)+35
 340 IF (BP=GP) OR (PEEK (BP-33)
=128 AND PEEK (BP+33)=128 AND PE
EK (BP-1)=128 AND PEEK (BP+1)=12
8) THEN GOTO 330
 350 POKE BP,52
 360 NEXT N
 370 REM ██ SET "LIVE" BOMB ██
 380 LET B$(INT (RND*5+1))="B"
 390 SLOW
 400 FOR N=1 TO 50
 410 NEXT N
 420 REM ██ MOVE ROUTINE ██
 430 POKE GP,21
 440 IF INKEY$="E" THEN GOTO 740
 450 LET GNP=GP+(INKEY$=".")*33-
(INKEY$="P")*33+(INKEY$="C")-(IN
KEY$="Z")
 460 IF PEEK GNP=128 THEN GOTO 4
30
 470 LET T=T+2
 480 IF PEEK GNP=52 THEN GOTO 53
0
 490 POKE GP,TRAIL
 500 LET GP=GNP
 510 IF T>450 THEN GOTO 730
 520 GOTO 430
 530 REM ██ REACHED A BOMB ██
 540 POKE GP,TRAIL
 550 LET GP=GNP
 560 POKE GP,21
 570 LET P=INT (RND*5+1)
 580 IF B$(P)=" " THEN GOTO 660
 590 IF B$(P)="D" THEN GOTO 570
 600 PRINT AT 0,1;"TIME TAKEN=";
T
 610 IF T<LSF THEN LET LSF=T
 620 PRINT AT 23,1;"LOWEST SO FA
R=";LSF
 630 IF INKEY$<>"" THEN GOTO 630
 640 IF INKEY$="" THEN GOTO 640
 650 GOTO 40
 660 REM ██ DUD BOMB ██
 670 PRINT AT 0,1;"DUD BOMB"
 680 LET B$(P)="D"
 690 FOR N=1 TO 50
 700 NEXT N
 710 PRINT AT 0,1;"████████"
 720 GOTO 430
 730 REM ██ TIME UP,EXPLOSION ██
 740 LET N=0
 750 POKE GP,N
 760 LET N=N+129
```

(continued on page 109)

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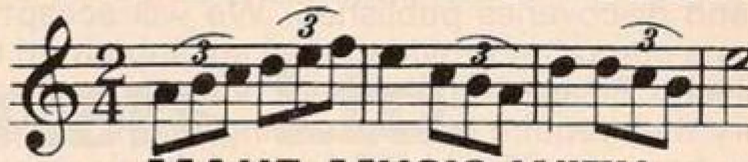
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(continued from page 107)

```
770 IF N>255 THEN LET N=N-256
780 IF N<>62 THEN GOTO 750
790 POKE GP,0
800 PRINT AT 23,0;"YOU HAVE FAILED."
810 GOTO 630
1000 REM AUTOMATIC RUN
1010 SAVE "MAZE"
1020 RUN
```

Slide show

Stewart Stallworthy,
Rickmansworth,
Hertfordshire.

SPECTRUM

THIS ROUTINE can be used to Poke to the screen any pre-defined picture or pictures. Whilst a Basic program would take approximately 60 seconds, this routine takes less than one second, and can therefore be usefully incorporated in Basic program. First draw a picture on the screen, then save it on tape —

```
SAVE "Picture" SCREEN
10 CLEAR 39997
20 FOR f=40000 TO 40048
30 INPUT a
40 POKE f,a
50 PRINT f,a
60 NEXT f
```

Run the program entering the appropriate decimal codes, and then Save on tape

```
SAVE "Slide" CODE 40000,48
```

The next step is to load the picture bytes into memory. The routine is written to look for them at memory address 40100.

```
CLEAR 39997
LOAD "Slide" CODE 40000,48
LOAD "Picture" CODE 40100,6912
```

Now type

```
RANDOMISE USR 40000
```

and all should be revealed. Each picture takes 6912 bytes, and additional pictures may be located at other memory addresses, for example 47013 and 53926. If these are used, it will be necessary to make the routine look at the correct starting address, and this is done as follows. For picture starting at memory address 47013,

```
POKE 40008,165
POKE 40009,183
```

For picture starting at memory address 53926,

```
POKE 40008,166
POKE 40009,210
```

ADDRESS	MACHINE CODE	MNEMONIC	COMMENT	ADDRESS	MACHINE CODE	MNEMONIC	COMMENT
40000	38	LD H N		5	50	LD(NN)A	POKE 39998,A
1	28			6	52		
2	46	LD L N	6912 into HL	7	156		
3	1			8	24	JR DIS	Jump to 40013
4	34	LD(NN)HL	HL into memory	9	238		
5	62		at39998 & 39999	40030	58	LD A(NN)	A=PEEK 39999
6	156			1	63		
7	17	LD DE NN	16384 into HL	2	156		
8	164			3	71	LD B A	B=A
9	156			4	61	DEC A	
40010	33	LD HL NN	16384 into HL	5	5	DEC B	
1	0			6	40	JRZ DIS	Jump to 40048 if
2	64			7	10		
3	26	LD A (DE)	A=PEEK DE	8	50	LD(NN)A	Poke 39999,A
4	119	LD (HL)A	POKE HL,A	9	63		
5	35	INC HL		40040	156		
6	19	INC DE		1	62	LD A N	255 into A
7	58	LD A(NN)	A=PEEK 39998	2	255		
8	62			3	50	LD(NN)A	Poke 39998,A
9	156			4	62		
40020	71	LD B A	B=A	5	156		
1	61	DEC A		6	24	JR DIS	Jump to 40013
2	5	DEC B		7	221		
3	40	JRZ DIS	Jump to 40030	8	201	RET	Back to Basic
4	5		if B=0				

Sounds familiar

David Rees,
Weybridge,
Surrey.

VIC-20

IF YOU HAVE been gazing enviously all year at the BBC's Envelope command and have come home to the flat tones of a Vic-20, this program should cheer you up. It creates sounds at machine-code speed and gives an extra 11 registers for sound control.

Program 1 Pokes the machine code into memory, as the basic Vic has no assembler. Care must be taken when you type in the program, as one error in the code can cause the computer to stay in machine-code mode until you switch it off. The best method for dealing with this is to Save the program before you Run it. Then, if there is a mistake, you can load the program and check it through.

After running program 1, you can New it as the machine code is all that is needed. It is located in the 256 bytes between 7424 and 7679, and the RAMtop has been moved down by this amount so that variables do not erase the program.

To use the command, you must first set the registers. There are 11 registers which have to be Poked to, and program 2 shows a convenient way of doing this.

The registers are as follows:

```
DATA S,FR(1),FR(2),FR(3),T(1),T(2),T(3),
     V(1),V(2),V(3),DT
```

S is the voice chosen, 0 is the low sound, 1 is the medium sound, 2 is the highest sound and 3 is the white noise generator.

FR(1), FR(2) and FR(3) are the numbers that are added to the frequency of the voice chosen each cycle. If the number of the frequency rises above 255, the command wraps it around so that the value becomes 128 plus the value by which it exceeded 255. This means that if you want the command to play several scales of notes there will be no gap in sound once the top of the scale is reached. The number that can be stored in these registers lies between 0 and 255.

T(1), T(2) and T(3) are the number of cycles through which the registers of each of the three parts are added to the sound and volume chosen. Again, the range of values lies between 0 and 255.

V(1), V(2) and V(3) are the numbers which change the volume of the sound each cycle. If 16 is Poked in here, volume does not change. A number lower than 16 lowers the volume, and a number greater than 16 raises it. The effective number can be calculated using 16−V(n).

DT is the delay time after each cycle is completed and can be between 0 and 255, with 0 having a delay time of 0.1ms. and the other numbers are measured in the computer in increments of 0.5ms.

If this seems complicated, program 3 gives the Basic equivalent of the main routine. You

(continued on next page)

(continued from previous page)

can also use this routine to demonstrate how much faster machine code is compared with Basic. Now all you have to do is type in SYS 7424 and the command will start. The registers will not change so SYS 7424 can be used anywhere and as many times as you want in a program. Registers can also be Poked individually so you can change a sound quickly.

You are now ready to create your own sound effects. The main advantage of this command is its speed. Basic cannot run faster than when 30 is Poked into the DT register. Lower numbers down to 5 can create fast, smooth sounds. When DT is 4 or less, sounds merge. These speeds are the most useful as you can mix tones and volume to create your own wave forms.

```
5 REM****PROGRAM 1****
10 POKE 51,255:POKE 52,28:POKE 55,255:POKE 56,28
20 FOR N=0 TO 152
30 READ A
40 POKE 7424+N,A
50 NEXT
60 DATA 24,173,252,29,41,31,141,252,29
70 DATA 173,253,29,41,31,141,253,29
80 DATA 173,254,29,41,31,141,254,29
90 DATA 173,245,29,41,3,141,245,29
100 DATA 169,10,133,1,169,144,133,2,169,0
110 DATA 141,241,29,141,242,29,169,246
120 DATA 133,251,169,29,133,252
130 DATA 172,245,29,177,1,172,241,29,24,113,251
140 DATA 144,3,24,105,128,24,172,245,29
150 DATA 145,1,172,241,29,200,200,200
160 DATA 238,242,29,200,200,200,177,251
170 DATA 24,109,14,144,233,15,24,184
180 DATA 141,14,144,172,255,29,192,0,240,8
190 DATA 162,120,202,208,253,136,208,248
200 DATA 172,241,29,200,200,200,177,251
210 DATA 205,242,29,208,181,238,241,29
220 DATA 169,3,205,241,29,208,6,169,0
230 DATA 141,241,29,96,169,0,76,46,29

999 REM****PROGRAM 2****
1000 FOR N = 0 TO 10:READ A:POKE 7669+N,A:NEXT N
1010 DATA 2,2,0,191,1,211,224,30,16,24,2
1020 SYS 7424:POKE 36876,0

99 REM****PROGRAM 3****
100 FOR A = 1 TO 3
110 FOR B = 1 TO T(A)
120 F = PEEK(36874 + S)+FR(A)
130 POKE 36874+S,(F AND 127)+128
140 V=PEEK(36878)-16+V(A)
150 POKE 36878,V AND 255
160 FOR T=0 TO DT:NEXT
170 NEXT
180 NEXT
```

TABLE 1

position	variable	range	function
7669	S	0-3	Voice choice(36874+S)
7670	FR(1)		Frequency + FR(n)
7671	FR(2)	0-255	each cycle
7672	FR(3)		
7673	T(1)		Number
7674	T(2)	0-255	of
7675	T(3)		cycles
7676	V(1)		Volume-16+V(n)
7677	V(2)	0-31	each
7678	V(3)		cycle
7679	DT	0-255	Delay time each cycle

EXAMPLES:

Helicopter
```
1010 DATA 0,2,4,1,8,8,200,30,15,15,1
1020 FOR N=0 TO 70:POKE 36874,240-N:SYS 7424:
NEXT:POKE 36874,0
```

Laser Gun
```
1010 DATA 2,2,4,1,8,8,200,30,16,0,2
1020 POKE 36876,99:POKE 36878,15:SYS 7424
```

Footsteps(walking)
```
1010 DATA 2,6,0,0,8,8,200,18,16,16,2
1020 POKE 36878,0:FOR N=0 to 10:SYS 7424:NEXT
```
For running,use 1 as last number in data

Echo
```
1010 DATA 2,0,127,1,0,8,9,16,16,16,0
1020 FOR N=0 to 9:POKE 36876,225
1030 FOR A=0 to 28:SYS 7424
1040 NEXT A,N
```

Field-gun

B Pearce,
Bath,
Avon.

BBC

THIS PROGRAM has been written for the BBC Model A Micro and uses almost all the available memory. Although it uses procedures which are, I believe, peculiar to the BBC Micro, there is no reason why it should not be adapted for Basic on other micros.

The game is for two players. There are two horizontal blocks representing a plain and a plateau, separated by mountains. The form of the mountains and the height of the plateau are both random, and the plateau may be right or left of the screen. Sited at a random position on the plain is a gun position, and another on the plateau. At the top of the screen a cross wind is specified, random left or right, random strength five to 40 mph in steps of 5 mph.

Player to start is specified, random left or right. The player is required to enter the gun elevation angle, which will be any angle between one to 90°, followed by muzzle velocity — any number from 1 to 20. On the second Return his gun fires a shell along the correct trajectory taking account of the effect of the wind. Each player fires in turn until one hits the others gun, when there is a flash and a bang. During the exchange, previous elevation and velocity settings are listed at each side of the screen for reference.

```
>L.L.
   10REM "FIELD-GUN" by B.Pearce
   20*TV255,1
   30CLEAR:CLS:MODE4:VDU19,1,3;0;:DIMA1(4):A%=32+4*RND(96):B%=832+4*RND(96):C%=256+4*RND(32)
   40D%=INT(16*(RND(1)-0.5))*5:IFD%=0THEN40
   50E%=2:F%=2:G%=RND(2):H%=1:I%=SGN(RND(1)-0.5):IFI%=1THEN80
   60PROCFLAT(0,96,128,448):PROCSLOPE(448,1,832):PROCFLAT(832,96,C%,1280)
   70MOVEA%,128:PROCFORT:MOVEB%,C%:PROCFORT:GOTO100
   80PROCFLAT(1280,96,128,832):PROCSLOPE(832,-1,448):PROCFLAT(448,96,C%,0)
   90MOVEA%,C%:PROCFORT:MOVEB%,128:PROCFORT
  100PRINTTAB(1,1);"E  V":PRINTTAB(33,1);"E  V":IFD%>1THEN120
  110PRINTTAB(12,1);"<- Wind ";-1*D%;" mph":GOTO130
  120PRINTTAB(12,1);"Wind ";D%;" mph ->"
  130G%=3-G%:IFG%=2THEN150
  140E%=E%+1:GOTO160
  150F%=F%+1
  160H%=H%+1:IFH%=2THEN170ELSE180
  170IFG%=2THENPRINTTAB(35,10);"RIGHT";TAB(35,11);"FIRES";TAB(35,12);"FIRST"ELSEPRINTTAB(0,10);"
LEFT"'"FIRES"'"FIRST"
  180IFH%=3THENPRINTTAB(0,10);"
                                                       "
  190INPUTTAB(8,4)"Elevation (1-90) = "J%:IFJ%<1ORJ%>90THEN190
  200IFG%=2THEN220
  210PRINTTAB(0,E%);J%:GOTO230
  220PRINTTAB(32,F%);J%
  230PRINTTAB(8,4);"                        "
  240INPUTTAB(8,8)"Velocity  (1-20) = "K:IFK<1ORK>20THEN240
  250IFG%=2THEN270
  260PRINTTAB(3,E%);K:GOTO280
  270PRINTTAB(35,F%);K
  280PRINTTAB(8,8);"                        "
  290IFG%=2THEN330
  300IFI%=1THEN320
  310MOVEA%,128:PROCSHOT(1,A%,128)
  320MOVEA%,C%:PROCSHOT(1,A%,C%)
  330IFI%=1THEN350
  340MOVEB%,C%:PROCSHOT(-1,B%,C%)
  350MOVEB%,128:PROCSHOT(-1,B%,128)
  360IFG%=2THEN380
  370IFa%>B%-16ANDa%<B%+16THEN390ELSE130
  380IFa%>A%-16ANDa%<A%+16THEN390ELSE130
  390PROCSOUND:PROCBANG:TIME=0:REPEAT:UNTILTIME=200:PRINTTAB(4,30);"Press SPACE BAR for another
game":c=GET:IFc=32THEN30
  400DEFPROCFLAT(K,L,M,N):MOVEK,L:PLOT5,K,M:PLOT85,N,L:PLOT85,N,M:ENDPROC
  410DEFPROCSLOPE(O,P,Q):FORR=1TO5:S%=O+64*P*R:T%=128+(C%-128)*R/5+(RND(128)-64)*R/2:PLOT85,S%,9
```

```
6:PLOT85,S%,T%:NEXT:PLOT85,Q,96:PLOT85,Q,C%:ENDPROC
  420DEFPROCFORT:PLOT65,-16,0:PLOT65,8,16:PLOT81,8,-16:ENDPROC
  430DEFPROCSHOT(U,V,W):X=6*COS(RAD(J%))*K:Y=6*SIN(RAD(J%))*K:Z=1:REPEAT:a%=U*X*Z+D%*Z^2/100+V:b
%=Y*Z-Z^2/0.48+W:A1(2)=A1(1):A1(1)=a%:A1(4)=A1(3):A1(3)=b%:IFPOINT(a%,b%)<>0ANDb%<512THEN360
  440PLOT69,a%,b%:PLOT71,A1(2),A1(4):Z=Z+0.5:UNTILb%<120:ENDPROC
  450DEFPROCBANG:PLOT1,-64,64:PLOT81,48,-32:PLOT1,-8,32:PLOT81,24,-32:PLOT1,32,96:PLOT81,-8,-64:
PLOT1,24,8:PLOT81,-48,-72:ENDPROC
  460DEFPROCSOUND:SOUND0,1,6,60:ENVELOPE1,5,0,0,0,0,0,0,30,-2,-5,-5,120,80:ENDPROC
>VDU1
```

Acorn pilot

Roy Pincott,
Mansfield,
Nottinghamshire.

ATOM

THIS FLIGHT simulation program, written for the Acorn Atom, gives you a pilot's eye view of aerobatic manoeuvres.

Use this Basic program to learn to fly the plane as though you were sitting inside it. The program has the facility to enable the user to perform victory rolls, loop the loop and fly upside down. A word of advice. It is necessary to remember which direction you are flying — towards or away from the screen — as this has a fundamental effect on the way the plane banks.

```
 10GOS.1000
 15DIMR(7)
 22G=£1740
 25S=£8000
100CLEAR4
101H=17;GOS.144
104GOS.a
120IF H=1;GOS.c;G=G-£100;GOS.2010
121IF H=2;GOS.c;GOS.2020
122IF H=3;GOS.c;G=G-£100;GOS.2030
123IF H=5;GOS.c;G=G-£100;GOS.2050
124IF H=6;GOS.c;GOS.2060
125IF H=7;GOS.c;G=G-£100;GOS.2070
128IF H=20;GOS.c;GOS.2200
129IF H=24;GOS.c;GOS.2240
130IF H=4;GOS.c;G=G-£200;GOS.2040
132IF H=8;GOS.c;G=G-£200;GOS.2080
134IF H=18;GOS.c;G=G-£200;GOS.2180
136IF H=22;GOS.c;G=G-£200;GOS.2220
140IF H=10;GOS.c;G=G+£1;GOS.2100
142IF H=14;GOS.c;G=G+£1;GOS.2140
144IF H=17;GOS.c;G=G-£FF;GOS.2170
146IF H=23;GOS.c;G=G-£FF;GOS.2230
150IF H=12;GOS.c;G=G-£1;GOS.2120
152IF H=16;GOS.c;G=G-£1;GOS.2160
154IF H=19;GOS.c;G=G-£101;GOS.2190
156IF H=21;GOS.c;G=G-£101;GOS.2210
160IF H=9;GOS.c;G=G+£20;GOS.2090
162IF H=11;GOS.c;G=G+£20;GOS.2110
164IF H=13;GOS.c;G=G+£20;GOS.2130
166IF H=15;GOS.c;G=G+£20;GOS.2150
295IF S+G<£8000;G.m
296IF S+G>£98FF;G.m
300F.B=1TO5;?£B000=?£B000 &£F0 +B
310B?£7F=?£B001 &8;N.B
330IF ?£81=0;GOS.d
340IF ?£82=0;GOS.e
350IF ?£83=0;GOS.f
360IF ?£84=0;GOS.g
999G.120
1000CLEAR0
1010P.$12''
1020P."           pilot        "''''"     BY roy pincott"'''
1100P."C BANK LEFT          B BANK RIGHT"''
1110P."E NOSE DOWN          D NOSE UP"''''
1200LINK £FFE3
1999R.
2010GOS.c;!R=£18E70000;R!4=£000000;H=1;GOS.a;R.
2020GOS.c;!R=£003C7EC3;R!4=£000018;H=2;GOS.a;R.
2030GOS.c;!R=£E7180000;R!4=£000000;H=3;GOS.a;R.
2040GOS.c;!R=£7E3C0018;R!4=£0000C3;H=4;GOS.a;R.
2050GOS.c;!R=£18E70000;R!4=£000000;H=5;GOS.a;R.
2060GOS.c;!R=£003C7EC3;R!4=£000018;H=6;GOS.a;R.
2070GOS.c;!R=£E7180000;R!4=£000000;H=7;GOS.a;R.
2080GOS.c;!R=£7E3C0018;R!4=£0000C3;H=8;GOS.a;R.
2090GOS.c;!R=£18040606;R!4=£060604;H=9;GOS.a;R.
2100GOS.c;!R=£7B7B70E0;R!4=£00E070;H=10;GOS.a;R.
2110GOS.c;!R=£06081818;R!4=£181808;H=11;GOS.a;R.
2120GOS.c;!R=£DEDE0E07;R!4=£00070E;H=12;GOS.a;R.
2130GOS.c;!R=£18040606;R!4=£060604;H=13;GOS.a;R.
2140GOS.c;!R=£7B7B70E0;R!4=£00E070;H=14;GOS.a;R.
2150GOS.c;!R=£06081818;R!4=£181808;H=15;GOS.a;R.
2160GOS.c;!R=£DEDE0E07;R!4=£00070E;H=16;GOS.a;R.
2170GOS.c;!R=£7B60C000;R!4=£000000;H=17;GOS.a;R.
2180GOS.c;!R=£18180018;R!4=£605838;H=18;GOS.a;R.
2190GOS.c;!R=£0306DE00;R!4=£000000;H=19;GOS.a;R.
2200GOS.c;!R=£181C1A06;R!4=£180018;H=20;GOS.a;R.
2210GOS.c;!R=£DE060300;R!4=£000000;H=21;GOS.a;R.
2220GOS.c;!R=£18180018;R!4=£061A1C;H=22;GOS.a;R.
2230GOS.c;!R=£C0607B00;R!4=£000000;H=23;GOS.a;R.
2240GOS.c;!R=£18385860;R!4=£180018;H=24;GOS.a;R.
```

(continued on page 113)

(continued from page 111)

```
4000dIF H=1;GOS.2020;R.
4002IF H=2;GOS.2030;R.
4004IF H=3;GOS.2040;R.
4006IF H=4;GOS.2010;R.
4008IF H=5;GOS.2060;R.
4010IF H=6;GOS.2070;R.
4012IF H=7;GOS.2080;R.
4014IF H=8;GOS.2050;R.
4016IF H=9;GOS.2120;R.
4018IF H=10;GOS.2090;R.
4020IF H=11;GOS.2100;R.
4022IF H=12;GOS.2110;R.
4023IF H=13;GOS.2160;R.
4024IF H=14;GOS.2130;R.
4026IF H=15;GOS.2140;R.
4027IF H=16;GOS.2150;R.
4028IF H=17;G=G-£100;GOS.2200;R.
4030IF H=18;GOS.2170;R.
4032IF H=19;GOS.2180;R.
4034IF H=20;GOS.2190;R.
4036IF H=21;GOS.2240;R.
4038IF H=22;GOS.2210;R.
4040IF H=23;GOS.2220;R.
4042IF H=24;GOS.2230;R.
4050R.
5000eIF H=1;GOS.2040;R.
5002IF H=2;GOS.2010;R.
5004IF H=3;GOS.2020;R.
5006IF H=4;GOS.2030;R.
5008IF H=5;GOS.2080;R.
5010IF H=6;GOS.2050;R.
5012IF H=7;GOS.2060;R.
5014IF H=8;GOS.2070;R.
5016IF H=9;GOS.2100;R.
5018IF H=10;GOS.2110;R.
5020IF H=11;GOS.2120;R.
5022IF H=12;GOS.2090;R.
5023IF H=13;GOS.2140;R.
5024IF H=14;GOS.2150;R.
5026IF H=15;GOS.2160;R.
5027IF H=16;GOS.2130;R.
5028IF H=17;G=G-£100;GOS.2180;R.
5030IF H=18;GOS.2190;R.
5032IF H=19;GOS.2200;R.
5034IF H=20;GOS.2170;R.
5036IF H=21;GOS.2220;R.
5038IF H=22;GOS.2230;R.
5040IF H=23;GOS.2240;R.
5042IF H=24;GOS.2210;R.
5050R.
6000fIF H=1;GOS.2150;R.
6002IF H=2;GOS.2240;R.
6004IF H=3;GOS.2110;R.
6006IF H=4;GOS.c;G=G-£200;GOS.2180;R.
6008IF H=5;GOS.2130;R.
6010IF H=6;GOS.2200;R.
6012IF H=7;GOS.2090;R.
6014IF H=8;GOS.c;G=G-£200;GOS.2220;R.
6016IF H=9;GOS.2010;R.
6018IF H=10;GOS.2170;R.
6020IF H=11;GOS.2050;R.
6022IF H=12;GOS.2210;R.
6023IF H=13;GOS.2030;R.
6024IF H=14;GOS.2230;R.
6026IF H=15;GOS.2070;R.
6027IF H=16;GOS.2190;R.
6028IF H=17;GOS.2140;R.
6030IF H=18;GOS.c;G=G-£200;GOS.2080;R.
6032IF H=19;GOS.2120;R.
6034IF H=20;GOS.2020;R.
6036IF H=21;GOS.2160;R.
6038IF H=22;GOS.c;G=G-£200;GOS.2040;R.
6040IF H=23;GOS.2100;R.
6042IF H=24;GOS.2060;R.
6050R.
7000gIF H=1;GOS.2090;R.
7002IF H=2;GOS.2200;R.
7004IF H=3;GOS.2130;R.
7006IF H=4;GOS.c;G=G-£200;GOS.2220;R.
7008IF H=5;GOS.2110;R.
7010IF H=6;GOS.2240;R.
7012IF H=7;GOS.2150;R.
7014IF H=8;GOS.c;G=G-£200;GOS.2180;R.
7016IF H=9;GOS.2070;R.
7018IF H=10;GOS.2230;R.
7020IF H=11;GOS.2030;R.
7022IF H=12;GOS.2190;R.
7023IF H=13;GOS.2050;R.
7024IF H=14;GOS.2170;R.
7026IF H=15;GOS.2010;R.
7027IF H=16;GOS.2210;R.
7028IF H=17;GOS.2100;R.
7030IF H=18;GOS.c;G=G-£200;GOS.2040;R.
7032IF H=19;GOS.2160;R.
7034IF H=20;GOS.2060;R.
7036IF H=21;GOS.2120;R.
7038IF H=22;GOS.c;G=G-£200;GOS.2080;R.
7040IF H=23;GOS.2140;R.
7042IF H=24;GOS.2020;R.
8000aF.V=0TO7;S?G=R?V;G=G+32;N.V;R.
8010bF.V=0TO7;S?H=R?V;H=H+32;N.V;R.
8100c!R=£00000000;R!4=£000000;H=G-£120;GOS.b
8110R.
8200mCLEAR0;P.$12;P."you crashed"
9999LINK £FFE3;G.15
```

Accelerator

Bob Boffin,
Woking,
Surrey.

DRAGON

DRAGON OWNERS may be interested in this simple way to speed up their Basic programs.

The technique uses the ability of the Motorola 6809E microprocessor to run in three different modes. The first mode uses a clock rate of 0.9 MHz and is the one used by the Dragon by default. The second mode uses a clock rate of 1.8 MHz but the processor does not output addresses for the video chip so no display is produced, hence this mode is not very useful. It is the third mode which is of interest. In this mode the processor runs at either 0.9 MHz or 1.8 MHz, depending on the address being accessed. Addresses in the range 0000-7FFF hexadecimal or FF00-FF1F hexadecimal are accessed at 0.9 MHz. All other addresses are accessed at 1.8 MHz.

Since the Basic interpreter is located starting at address 8000 hex, if dual rate is selected it will run at 1.8 MHz except when it is accessing RAM. This gives a very significant improvement in Basic performance.

Selection of the processor mode is simple.

```
POKE &HFFD7,0   will switch dual rate on
POKE &HFFD6,0   will switch dual rate off
```

Pressing the Reset button on the side of the Dragon will also Reset the processor mode to normal. Any value may be Poked. It is the act of writing to the location which toggles the switch. If you Peek at these locations they always return the same result.

When you try this on your Dragon the first thing you will notice is that the cursor blinks very much faster. This is an easy way to tell which mode you are in.

A few simple benchmarks will show that the Dragon is now running appreciably faster. The biggest improvement will be found in number-crunching programs where most of the accesses will be at the faster rate. These can show up to 70 percent improvement.

There are some side-effects to using the dual rate. The notes produced by the Sound command will be about an octave higher. Do not use CLoad, CSave or any commands which use the cassette interface while in dual rate as the port address used is accessed at the higher rate. You can switch between the two rates within your Basic program if necessary.

Array sort

Alan Stevens,
Alvaston,
Derbyshire.

MZ-80K

THIS BASIC listing of the Quicksort algorithm is for sorting an array, A(x), of elements, x, into order. The first part of the program simply generates 100 random numbers for the sort routine to work on. The sort subroutine itself consists of lines 1000-1130.

One of the interesting features of the program is that the sort subroutine calls itself recursively — a feature widely regarded as being not possible in Basic.

Those who believe that recursion is not possible in Basic are perhaps being confused by the fact that Basic does not support local variables — recursion is generally much more useful when local variables are available within the subroutine. The other interesting feature of my program, therefore, is the simulation of local variables by the use of subscripted variables. The subscript, S, is increased by one at each entry to the subroutine, and decreased by one at each exit.

(continued on next page)

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The program takes about 17 seconds to sort 100 random numbers, about 13 seconds for 100 numbers in reverse order.

The number of nested subroutines required depends on the ordering of the elements in, and the size of the array. For 100 randomly arranged numbers the average number of nested subroutines is 12 — found from experience, though occasionally, as many as 15 are needed.

The MZ-80K allows 15 nested subroutines, which is why arrays L(S) and HI(S) are Dimensioned as shown in line 20. The program may be simply modified for machines which support M nested subroutines by Dimensioning L(M + 1) and HI(M + 1).

If 15 (or M) nested subroutines are not sufficient, the following lines may be added to the program to extend its range:

```
105 F=0
165 IF F=1 THEN 100
1005 IF S>15 THEN F=1
1006 IF F=1 THEN 1130
```

These lines effectively reinitialise the sort which restarts with an already partly sorted array.

```
10   REM N=NUMBER of ELEMENTS TO BE SORTED:N=100
20   DIM L(16),HI(16),A(N)
30   REM GENERATE AND PRINT N RANDOM INTEGERS
40   FOR R=1 TO N
50   A(R)=INT(N*RND(1))
60   PRINT A(R);
70   NEXT R
80   PRINT:PRINT
90   REM  SET INITIAL CONDITIONS AND CALL QUICKSORT
100  LO=1:HI(1)=N:S=0
110  GOSUB 1000
120  REM PRINT SORTED ARRAY
130  FOR R=1 TO N
140  PRINT A(R);
150  NEXT R
160  PRINT
170  END
900  REM  QUICKSORT SUBROUTINE
1000 S=S+1
1010 L=LO:H=HI(S)
1020 M=A((L+H)/2)
1030 IF A(L)<M THEN L=L+1:GOTO 1030
1040 IF A(H)>M THEN H=H+1:GOTO 1040
1050 IF L>H THEN 1100
1060 T=A(L):A(L)=A(H):A(H)=T
1070 L=L+1:H=H-1
1080 GOTO 1030
1090 REM SET CONDITIOMNS AND RECALL QUICKSORT IF NECESSARY
1100 L(S)=L
1110 IF LO<H THEN HI(S+1)=H:GOSUB 1000
1120 IF HI(S)>L(S) THEN LO=L(S):HI(S+1)=HI(S):GOSUB 1000
1130 S=S-1:RETURN
```

Blitz

Shingo Sugiura,
Tokyo,
Japan.

BBC

THIS PROGRAM is for the BBC Micro model B. It is similar to the Vic-20 game Blitz, although there are a few extras in this implementation. You are in control of an aeroplane rapidly losing altitude. Below you are skyscrapers which you must bomb and flatten enough to land. It plays a nice little tune when you succeed but when you crash the effect is spectacular. If you find the game too fast or too slow, change the speed value given in line 350.

30	SETS F0 KEY
40~140	DEFINES CHARACTERS
150	SOUND FOR BOMBING
160,170	INSTRUCTIONS
180	DEFINES BOMB$
190~300	SET SCREEN
310	INITIALISE STRINGS AND VARIABLES
320	TESTS FOR SPACE BAR
330	PRINTS AEROPLANE
340	CHECK IF PLANE HAS LANDED
350	SLOW DOWN THE PLANE
360	CHECKS IF PLANE HAS CRASHED
370	CALCULATES PLANE'S NEXT POSITION
380	SEE IF BOMB IS ON THE SCREEN
390	PRINT BOMB
400	SEE IF BOMB HAS HIT BUILDINGS
410	EMPTY KEYBOARD BUFFER
420	GOTO320
430~550	INSTRUCTIONS PROCEDURE
560~600	CRASHING PROCEDURE
610~630	BOMB PROCEDURE
640~660	DESTRUCTING PROCEDURE
670~720	INITIALISING STRINGS AND VARIABLES
730~740	POSITION CALCULATING PROCEDURE
750~790	LAND PROCEDURE
800~870	SMASHING PROCEDURE

```
10 REM BLITZ
20 REM (C) SHINGO SUGIURA
30 *KEY0"RUN|M"
40 VDU23,224,90,126,90,126,90,126,90,126
50 VDU23,225,90,126,90,90,126,90,90,126
60 VDU23,226,102,126,102,126,102,126,102,126
70 VDU23,227,0,0,24,24,36,126,90,126
80 VDU23,228,60,60,24,24,60,90,126,90
90 VDU23,229,24,24,24,24,60,126,102,126
100 VDU23,230,0,32,112,248,252,127,63,0
110 VDU23,231,0,0,0,1,241,255,253,1
120 VDU23,232,126,60,24,60,126,126,60,24
130 VDU23,233,32,124,254,127,63,31,31,31
140 VDU23,234,0,8,4,102,249,248,252,252
150 ENVELOPE1,1,11,-6,1,10,30,60,127,0,0,-127,126,0
160 MODE7
170 PROCINSTRUCTIONS
180 IF DL=1 THEN DESTRUCT$=" "+CHR$(10)+CHR$(8)+" " ELSE DESTRUCT$=" "+CHR$(10
)+CHR$(8)+" "+CHR$(10)+CHR$(8)+" "
190 MODE2
200 COLOUR134:CLS
210 VDU23;10,32;0;0;0;
220 FOR BUILD%=2 TO 18
230 COLOUR0
240 A=RND(3)+223
250 FOR HEIGHT%=29 TO RND(C*4)+(20-C*2) STEP-1
260 PRINT TAB(BUILD%,HEIGHT%);CHR$(A)
270 NEXT HEIGHT%
280 PRINTTAB(BUILD%,HEIGHT%+1);CHR$(A+3)
290 SOUND1,-15,RND(200),1
300 NEXT BUILD%
310 PROCINIT
320 FIRE$=INKEY$(0):IF FIRE$=" "THEN PROCBOMB
330 COLOUR1:PRINTTAB(X,Y);AERO$:SOUND0,-5,100,2
340 VDU26:IF POINT((X+2)*64+32,(30-Y)*32)=0 AND POINT((X+3)*64+32,(30-Y)*32)=0
AND POINT((X+4)*64+32,(30-Y)*32)=0 THEN PROCLAND
350 FOR SPEED=1 TO 80:NEXT SPEED
360 IF POINT((X+4)*64+32,(31-Y)*32)=0 THEN PROCCRASH:PROCDROP
370 PROCMOVE
380 IF FIRE=0 THEN 320
390 COLOUR3:PRINTTAB(XB,YB);BOMB$
400 YB=YB+1:IF YB>=28 OR POINT(XB*64+32,(30-YB)*32)=0 THEN PROCDESTRUCT ELSE 3
30
410 *FX15,0
420 GOTO320
430 DEFPROCINSTRUCTIONS
440 PRINTTAB(13,10);CHR$(141);CHR$(132);"BLITZ"
450 PRINTTAB(13,11);CHR$(141);CHR$(132);"BLITZ"
460 PRINTTAB(2,13);CHR$(135);"YOU MUST DESTROY THE BUILDINGS FLAT"
470 PRINTTAB(3,14);CHR$(135);"ENOUGH TO LAND YOUR AEROPLANE"
480 PRINTTAB(5,18);CHR$(135);"PRESS SPACE BAR TO DROP BOMB"
```

```
490 INPUT"          INPUT DESTRUCT LEVEL(1 TO 2)",DL
500 IF DL<1 OR DL>2 THEN 490
510 INPUT"          INPUT DIFFICULTY LEVEL(1 TO 5)",C
520 IF C<1 OR C>5 THEN 510
530 PRINT TAB(5,21);"PRESS f0 TO RESTART"
540 PRINTTAB(5,22);"PRESS ANY KEY TO START":ST$=GET$
550 ENDPROC
560 DEFPROCCRASH:SOUND0,-15,100,18
570 FOR CRASH=1 TO 10
580 FOR RIGHT=1 TO 10:VDU23;13,RIGHT,0;0;0;:NEXT RIGHT
590 FOR LEFT=10 TO 1 STEP-1:VDU23;13,LEFT,0;0;0;:NEXTLEFT
600 NEXT CRASH:ENDPROC
610 DEFPROCBOMB
620 FIRE=1:XB=X+2:YB=Y:IF XB>=20 THEN PROCDESTRUCT
630 ENDPROC
640 DEFPROCDESTRUCT
650 SOUND1,1,100,2:FIRE=0:PRINTTAB(XB,YB);DESTRUCT$:SOUND0,-5,100,2
660 ENDPROC
670 DEFPROCINIT:X=1:Y=3:FIRE=0
680 BOMB$=" "+CHR$10+CHR$8+CHR$232
690 AERO$=" "+" "+CHR$230+CHR$231
700 DROP$=" "+CHR$10+CHR$8+CHR$233
710 DROPT$=" "+CHR$10+CHR$8+CHR$234
720 ENDPROC
730 DEFPROCMOVE:X=X+1:IF X>=20 THEN X=0:Y=Y+1
740 ENDPROC
750 DEFPROCLAND
760 PRINTTAB(1,2);"WELL DONE":RESTORE780:FOR MUSIC=1 TO 10:READ A,B
770 SOUND2,-10,A,B:NEXTMUSIC:END:ENDPROC
780 DATA129,10,117,5,121,5,129,10,101,10
790 DATA121,5,129,5,137,5,145,5,149,5
800 DEFPROCDROP:XD=X+2:XDT=X+3:YD=Y-2:YDT=Y-2
810 FOR DELAY=1 TO 300:NEXT DELAY
820 YD=YD+1:PRINTTAB(XD,YD);DROP$
830 VDU26
840 IF POINT(XD*64+32,(29-YD)*32)=0 OR YD>=28 THEN 850 ELSE 820
850 YDT=YDT+1:PRINTTAB(XDT,YDT);DROPT$
860 VDU26
870 IF POINT(XDT*64+32,(29-YDT)*32)=0 OR YDT>=28 THEN END ELSE 850:ENDPROC
```

Quick copy

Peter Hintjens, Edinburgh.

VIC-20

THIS BASIC program will load into a chosen area of memory a routine that, whenever Ctrl P is pressed, will produce a quick copy of the Vic screen.

The machine-code routine becomes part of the system interrupt — IRQ — and is called 60 times a second when it can look at the keyboard and take whatever action is necessary.

Enter, check and Save the program, then Run it. At the start you will be asked where the code should go. Normally this will be at the top of memory, but in some cases, for example when using machine code that needs this area, you will want to specify somewhere else. In the first case the program will lower the memory pointers to protect the code, but if you specify a location you must protect it as necessary. A useful free area of memory is the 3K expansion block, if both a 3K and 8K or 16K expansion are fitted.

As the program loads the machine-code data, you may get a number of error messages of the form

?DATA ERROR IN

showing that that data line has been incorrectly entered. If the check sum at the end of each data line fails to pick up the error, the total count — TT — should catch it. When any data error is found, a flag ER is set and the program continues, perhaps to find more errors. After the load, if ER is set then the run is aborted and the memory pointers restored to their initial value, line 570.

As the program is relocatable, certain values must be altered to suit its start — specifically the start of the IRQ wedge. The screen page is also Poked into the routine so that the code will run in any memory size.

When the data has been loaded and assuming that there have been no errors, you will be told the actual start of the routine. Make a note of this number because to prime the code you must type: SYS, then the start address, then press Return. Pressing Stop/Restore will stop the effect of CtrlP.

You can alter the printing parameters — normally double-width and minimum line feed — by the follwing Pokes:

POKE (START) + 99, 15:
POKE (START) + 176, 15

for single-width printing and

POKE (START) + 161, 15

for normal line feeds, useful when dealing only with screens of text. The machine-code routine will automatically print in upper or lower case as set by the shift keys.

Once you have the program working you may take out the data checks — remove the ninth data byte of each line and change lines as follows. 310 to 460 replaced by:

```
310 FOR J = 0 TO 207
320 READ DA: POKE PO + J, DA
330 NEXT J
```

Lines 540 to 570 would be deleted.

```
10 REM** VIC SCREEN DUMP **
20 REM**       BY        **
30 REM**   P. HINTJENS   **
40 REM
50 REM
60 M1 = PEEK (56): M2 = PEEK (55): REM** INITIAL MEMORY POINTERS
70 REM
80 REM** GET CODE START
90 REM
100 PRINT "■■WHERE SHOULD THE CODE RESIDE ?"
110 PRINT "■1 - TOP-OF-MEMORY"
120 PRINT "■2 - SOMEWHERE ELSE"
130 PRINT "■■CHOICE ?"
140 GET A$:IF A$ = "2" GOTO 240
150 IF A$ <> "1" GOTO 140
160 REM
170 REM** DEALLOCATE TOP OF MEMORY BY 256 BYTES
180 REM
190 PO = 256 * M1 + M2 - 256: POKE 56, M1 - 1: POKE 52, M1 - 1
200 PRINT "■";: GOTO 270
```

(continued on page 117)

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```
210 REM
220 REM** USER CHOOSES LOCATION FOR CODE
230 REM
240 PRINT "XALLOW 208 BYTES FOR   CODE."
250 INPUT "XSTART POSITION"; PO: PO = INT (ABS (PO))
260 PRINT "JPLEASE PROTECT MEMORY AS REQUIRED."
270 PRINT "XSTART OF CODE =" PO
280 REM
290 REM** LOAD CODE INTO 208 BYTE BLOCK STARTING AT 'PO'
300 REM
310 TT = 0: REM** CHECK TOTAL FOR ALL DATA
320 FOR LINE = 0 TO 25: REM** SPLIT DATA INTO LINES FOR CHECKING
330 CS = 0: REM** CHECKSUM FOR DATA LINE
340 FOR J = 0 TO 7: READ DA: CS = CS + DA
350 POKE PO + LI * 8 + J, DA
360 NEXT J: TT = TT + CS
370 CS = CS AND 255: REM** CHECKSUM MOD 256
380 READ DA: TT = TT + DA
390 REM
400 REM** IS THE LINE OKAY?  (LOCATIONS 63-64 HOLD DATA LINE NUMBER)
410 REM
420 IF CS <> DA THEN PRINT "X?DATA ERROR IN"PEEK (63) + 256
    * PEEK (64): ER = 1
430 REM** DON'T STOP AFTER FIRST ERROR BUT SET FLAG 'ER'
440 NEXT LINE
450 IF ER THEN PRINT "X?PROGRAM ABORTED": GOTO 570: REM** ABORT
    AND RESTORE MEMORY
460 IF TT <> 30196 THEN PRINT "X?DATA ERROR, POSITION  UNKNOWN.":
    GOTO 570: REM* * ABORT
470 REM** ALTER POSITION-SPECIFIC LOCATIONS
480 POKE PO + 2, (PO + 13) AND 255: REM** NEW IRQ VALUES (LOW)
490 POKE PO + 7, (PO + 13) / 256: REM** (AND HIGH)
500 POKE PO + 84, PEEK (648): REM** SCREEN LOCATION
510 PRINT "XTYPE 'SYS"PO"I' <RET> TO PRIME THE CODE."
520 PRINT "XPRESS CTRL-P ONCE FOR A DUMP AT ANY[illegible] TIME."
530 END: REM** CODE OKAY AND IN MEMORY
540 REM
550 REM** ABORT SEQUENCE - RESTORE MEMORY POINTERS
560 REM
570 POKE 56, M1: POKE 52, M1: POKE 55, M2: POKE 51, M2
580 REM** DATA FOR MACHINE CODE
590 DATA 120, 169, 13, 141, 20, 3, 169, 28, 151
600 DATA 141, 21, 3, 88, 96, 72, 152, 72, 133
610 DATA 138, 72, 165, 197, 197, 253, 240, 13, 251
620 DATA 133, 253, 201, 13, 208, 7, 173, 141, 105
630 DATA 2, 201, 4, 240, 8, 104, 170, 104, 65
640 DATA 168, 104, 76, 191, 234, 120, 169, 0, 38
650 DATA 32, 189, 255, 173, 5, 144, 160, 255, 189
660 DATA 162, 4, 41, 15, 240, 2, 160, 7, 119
670 DATA 169, 4, 32, 186, 255, 32, 192, 255, 101
680 DATA 162, 4, 32, 201, 255, 176, 114, 169, 89
690 DATA 0, 133, 251, 169, 30, 133, 252, 32, 232
700 DATA 237, 255, 134, 1, 134, 0, 132, 2, 127
710 DATA 160, 0, 169, 14, 32, 210, 255, 177, 249
720 DATA 251, 201, 128, 144, 9, 41, 127, 72, 205
730 DATA 169, 18, 32, 210, 255, 104, 201, 34, 255
740 DATA 208, 2, 169, 39, 201, 32, 144, 8, 35
750 DATA 201, 64, 144, 7, 9, 128, 208, 3, 252
760 DATA 24, 105, 64, 32, 210, 255, 169, 146, 237
770 DATA 32, 210, 255, 200, 208, 2, 230, 252, 109
780 DATA 198, 1, 208, 203, 198, 2, 240, 27, 53
790 DATA 169, 8, 32, 210, 255, 169, 13, 32, 120
800 DATA 210, 255, 169, 15, 32, 210, 255, 169, 35
810 DATA 14, 32, 210, 255, 166, 0, 134, 1, 44
820 DATA 24, 144, 172, 169, 13, 32, 210, 255, 251
830 DATA32,231,255,104,170,104,168,104,144
840 DATA 88, 76, 191, 234, 234, 234, 234, 234, 245
```

Graphic aid

John Buchanan,
East Horsley, Surrey.

SPECTRUM

THIS IS a machine-code routine to overcome an annoying feature of Sinclair Basic: the CLS command must follow a global Paper Ink, Flash or Bright command or statement. This means that if you have created a screenful of high-resolution graphics and you want to make the whole screen flash or change the Ink or Paper colour over the whole screen, you have to execute a global colour statement then clear your display and then redraw it.

This can be undesirable especially if your display took a long time to draw. The machine-code routine can be called during or after the program execution. The new attributes for the screen are set using the Randomise N sequence where N is chosen, according to page 116 of the manual. Then the routine is executed by a call to 1+RAMtop - this is 32570 on the 16K machine.

```
  10 REM GRAPHICS UTILITY m/c
  20 REM © J.N.Buchanan 1982
  30 REM
  40 CLEAR (PEEK 23730+256*PEEK
23731)-15
  50 LET P=PEEK 23730+256*PEEK 2
3731: FOR F=1 TO 15: READ A: POK
E P+F,A: NEXT F
  60 DATA 62,91,237,75,118,92,33
,0,88,113,35,188,200,24,-6
  70 NEW
```

```
  10 REM Demonstration Program
  20 REM
  30 LET A=INT (256*RND)-128
  40 LET B=INT (172*RND)-85
  50 PLOT 128,86: DRAW A,B,PI/2*
RND+0.1
  60 BEEP 0.3,50*RND-25
  70 RANDOMIZE
  80 LET l=USR 32570
  90 PAUSE 45
 100 GO TO 10
```

Function copy

John Crombie,
Lisburn,
County Antrim.

ATOM

THIS SHORT program for the Acorn Atom simulates the function keys of the BBC Micro. The functions to be executed are held in strings and executed by pressing Shift plus the string name so the string will be executed as if

$A = "PRINT""ATOM FUNCTION KEYS"""

typed from the keyboard by typing Shift A. If a carriage return is required at the end of the function a Ctrl A should be substituted in the function string so

$L = "LIST(CTRL A)"

will execute List(CR) every time Shift L is pressed.

Line 130 sets up where the functions are going to be stored: in this case # 8200. Each function string is limited to 63 characters, so total storage for the 26 functions is 1,008 bytes. Line 290 changes the character input vectors. Lines 310-330 dimension the other strings and default them to a single space, while lines 170-265 contain the actual machine-code routine required.

```
10REM******************************
20REM* ATOM FUNCTION KEYS
30REM*
40REM* (C) J.CROMBIE      1982
50REM*
60REM* FUNCTION KEYS
70REM*    SHIFT A - SHIFT Z
80REM* FUNCTION HELD IN
90REM*          $A - $Z
100REM*****************************
110REM
120REM
130 A=#8200
140 DIM VV6:VV2=#2800:P.$21
150 FOR I=1 TO 2 :P=#2800
160[
170:VV0 JSR#FE94:CMP@#61:BMIVV1:CMP@#7B:BPLVV1
180JSRVV2::VV1RTS
190:VV2SEC:SBC@#61:STY#AD:TAY:STX#AC:LDX#AD
200 LDA#322,Y:STA#AE
210 LDA#33D,Y:STA#AF
220 LDY@0
```

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```
230:VV3 INY:LDA(#AE).Y:CMP@#D:BEQVV4
240DEY;LDA(#AE),Y;STA#100.X;INX
250INY;JSR#FE52:JMPVV3
260:VV4DEY;LDA(#AE),Y:CMP@1:BNEVV5:LDA@#D
265:VV5 STX#AE:LDY#AE;LDX#AC:RTS
270]
280N.:P.$6
290?#20A=0:?#20B=#28
310FOR @=0 TO 25:@?#322=?#322+@*63
320@?#33D=(?#322+@*63)/256+?#33D
330!(@?#33D*256+@?#322)=#20200D20:N.
340END
```

Screen scroll

Martin Layley, Wokingham, Berkshire.

DRAGON

According to the Dragon manual, when using Get and Put to move blocks of graphics, an array has to be Dimensioned to the same size or greater than the area of the graphics block. This is not so. In fact, you can get away with much less space in the array. The manual says that to Get a 20 by 20 block from the screen you need an array of (19,19). But you only need:

(0,100) in modes 3 and 4
(0,50) in modes 1 and 2
(0,25) in mode 0

The reason for this is that each element in an array takes five bytes, and that the computer stores more than one pixel in each byte.

The way of working this out is as follows: first, multiply the horizontal size of the graphics block, by the vertical size, then divide this by five and round up to the next nearest whole number. Next, for modes 3 and 4, divide by eight; for modes 1 and 2, divide by 16; for mode 0 divide by 32. Now round up to the next whole number. Finally, dimension the array with 0 as the first parameter, and the number which you have just arrived at as the second.

```
1 '**SCREEN SCROLLER
2 '
3 '**MARTIN LAYLEY 1982
4 '
5 '**SET GRAPHICS SCREEN
6 PMODE 4:SCREEN 1,1:COLOR 0,5:PCLS
7 '**DIMENSION ARRAYS
8 DIM L(0,76),S(0,1190)
9 '**DRAW ELLIPSE
10 CIRCLE (128,95),128,0,.75
11 'SHIFT SCREEN 10 PIXEL TO THE LEFT
12 GET (0,0)-(9,191),L
13 GET (10,0)-(255,191),S
14 PUT (245,0)-(255,191),L
15 PUT (0,0)-(244,191),S
16 GOTO 12
```

Relocate screen

Paul Dunning, Bristol, Avon.

ATARI

This program demonstrates how it is possible to relocate the screen in any part of memory on the Atari computer. It does this by Poking two addresses near the beginning of the display list with the high and low bytes of the memory location that you wish the screen to be placed at. Unfortunately the position of the display list varies depending on the graphics mode.

If you Peek memory locations 560 and 561 they will give you the high and low bytes of the address of the display list. You then add four to this in order to get the address to Poke the new screen location. Line 10 does this.

The variables are as follows: SP is the location to Poke low byte of screen; SP+1 is the location to Poke high byte of screen.

```
5 GRAPHICS 7:POKE755,1
6 ?:?"SMOOTH SCROLLING IN
  GRAPHICS 7"
10 SP=PEEK(560)+PEEK(561)*256+4
12 POKESP,176:POKESP+1,163
20 S=176:H=163
25 GOTO60
30 S=S+40:IFS>255 THEN S=S-256:
   H=H+1
40 POKESP,S:POKESP+1,H
50 RETURN
60 ST=STICK(0)
70 IFST=14 AND H>163 THEN GOSUB100
80 IFST=13 AND H<191 THEN GOSUB30
90 GOTO60
100 S=S-40:IFS<0 THEN S=S+256:H=H-1
110 POKESP,S:POKESP+1,H
120 RETURN
```

Use a joystick in port 1 to scroll the screen up and down memory.

Tight security

Andrew Ho, Leicester.

ZX-81

Ideas for maintaining program confidentiality have been published before in Basic, requiring the user to input a secret codeword before the program will run. Such security checks are easily bypassed in Basic by the use of Break or Stop keys. This code routine cannot be circumvented. The machine code is stored in a Rem statement containing 50 characters, as the first line of the program. Since many hexadecimal machine-code loading programs have been published, it is not necessary to repeat one here.

The routine starting at 16516 prints a screen prompt, then calls the key-scan subroutine in ROM many thousand times, seeking for a secret combination of keys to be pressed. If this is not found within 27 seconds, it jumps to the New subroutine in ROM and erases the program, thus preventing unauthorised access. To be effective, this idea should be incorporated in a program which auto-runs on loading from cassette.

The line following the program line containing Save should enter the machine-code routine at 16516 immediately, as illustrated in the sample program. The routine will work in both 1K and 16K machines, although it will probably find more use in 16K programs which might store confidential information. The screen is cleared and the counter reset before entry to the main program, so that further copies of the program will still feature this security check.

The secret codeword may be two, three or any number of any keys to be simultaneously pressed, thus making it impossible for uninformed users to breach the security check.

Your own secret codeword can be used if you understand how the key-scan routine operates in ROM. For those who do not, here are some possibilities:

16535	16536	codeword
9D	D9	AHO
7D	F1	ASM
7B	F3	WM
AE	E6	Shift X 7J

Address	Hexadecimal code	Explanation	
16514	FF 63	Set counter	
	3E 28 D7		
	3E 34 D7		
	3E 29 D7	Print screen prompt	
	3E 2A D7		
	3E 0F D7		
16531 loop	CD BB 02	Call Keyscan	
	11 9D D9	LD DE, secret code	
	AF	XOR A	
	ED 52	SBC HL, DE	
	28 0D	JR Z, +13	
16542	2A 82 40	LD HL, (16514)	
	2B	DEC HL	
	22 82 40	LD (16514), HL	
	BC	CP H	
	20 EB	JR NZ, loop	
	C3 C3 03	JP NEW	
	CD 2A 0A	Call CLS	
	3E 63	LD A, 63	Reset
	32 83 40	LD (16515), A	Counter
16563	C9	RET	

Andrew Ho's protection program.

```
9000 SAVE "program name"
9010 RAND USR 16516
9020 RUN or GOTO start of program
```

Sample program.

Code machine

Kenneth Hart,
New Crofton,
Wakefield.

ZX-81

THIS PROGRAM turns a sentence into a series of blocks of five-figure code.

There are 65,535 different codes available and the code can be a different length to the original message.

I have built into the program a copy routine which is only marginally slower than the inbuilt copy routine.

The advantage is that it only prints one blank line and therefore saves paper.

```
   0 REM A  K.HART PROGRAM FOR
         THE 16K. ZX81  22-6-82
         THE CODE MACHINE
  10 PRINT AT 1,7;"THE CODE MACH
INE"
  20 PRINT
  30 PRINT "PLEASE PRESS ""C"" T
O CODE OR";TAB 13;"""D"" TO DECO
DE"
  40 LET A$=INKEY$
  50 IF NOT (A$="C" OR A$="D") T
HEN GOTO 40
  60 CLS
  70 PRINT AT 1,3;"PLEASE INPUT
CODE NUMBER";TAB 6;"( 1 TO 65535
 )"
  80 INPUT A
  90 IF A<1 OR A>65535 THEN GOTO
 80
 100 CLS
 110 RAND A
 120 IF A$="D" THEN GOTO 1000
 130 PRINT AT 1,3;"PLEASE INPUT
YOUR MESSAGE";TAB 7;"( MAX. 14 L
INES )"
 140 INPUT B$
 150 LET B=LEN B$
 160 IF B<453 THEN GOTO 220
 170 PRINT AT 4,3;"THIS MESSAGE
IS TO LONG"
 180 FOR F=1 TO 100
 190 NEXT F
 200 PRINT AT 4,3;"
        "
 210 GOTO 140
 220 IF B/5<>INT (B/5) THEN LET
B$=B$+" "
 230 IF B/5<>INT (B/5) THEN GOTO
 150
 240 CLS
 250 PRINT "CODE ";A
 260 PRINT "YOUR MESSAGE IS:-"
 270 PRINT B$
 280 GOSUB 2000
 290 FAST
 300 DIM C$(B)
 310 FOR I=1 TO B
 320 IF B$(I)=" " THEN LET B$(I)
=" . "
 330 LET C=CODE B$(I)+INT (RND*2
5)
 340 IF C>63 THEN LET C=C-37
 350 LET C$(I)=CHR$ C
 360 NEXT I
 370 LET L=0
 380 PRINT "CODE ";A
 390 PRINT "THE CODE IS:-"
 400 FOR I=1 TO B STEP 5
 410 FOR F=0 TO 4
 420 LET L=L+1
 430 PRINT C$(I+F);
 440 NEXT F
 450 PRINT " ";
 460 IF L/25=INT (L/25) THEN PRI
NT
 470 NEXT I
 480 SLOW
 490 GOSUB 2000
 500 GOTO 1400
1000 PRINT AT 1,1;"PLEASE INPUT
THE CODED MESSAGE"
1010 PRINT " ( MAX 18 LINES BY 2
5 LETTERS )"
1020 INPUT B$
1030 LET B=LEN B$
1040 IF B<577 THEN GOTO 1100
1050 PRINT AT 4,8;"THIS IS TO LO
NG"
1060 FOR F=1 TO 100
1070 NEXT F
1080 PRINT AT 4,8;"
  "
1090 GOTO 1020
1100 CLS
1110 PRINT "CODE ";A
1120 PRINT "CODED MESSAGE IS:-"
1130 PRINT B$
1140 GOSUB 2000
1150 FAST
1160 DIM C$(B)
1170 LET C=0
1180 FOR I=1 TO B
1190 IF B$(I)=" " THEN GOTO 1250
1200 LET C=C+1
1210 LET D=CODE B$(I)-INT (RND*2
5)
1220 IF D<27 AND D<>0 THEN LET D
=D+37
1230 LET C$(C)=CHR$ D
1240 IF C$(C)="." THEN LET C$(C)
=" "
1250 NEXT I
1260 CLS
1270 PRINT "CODE ";A
1280 PRINT "THE MESSAGE IS:-"
1290 PRINT C$
1300 SLOW
1310 GOSUB 2000
1400 PRINT "PRESS ANY KEY TO CON
TINUE"
1410 PRINT " OR ""NEWLINE"" TO S
TOP"
1420 LET E=CODE INKEY$
1430 IF E=0 THEN GOTO 1420
1440 CLS
1450 IF E<>118 THEN RUN
1460 STOP
2000 PRINT AT 21,0;". DO YOU WAN
T A COPY (Y OR N)? "
2010 LET Q$=INKEY$
2020 IF NOT (Q$="Y" OR Q$="N") T
HEN GOTO 2010
2030 IF Q$="N" THEN GOTO 2160
2040 PRINT AT 21,0;".   I AM MAKI
NG A COPY FOR YOU   "
2050 LET F=0
2060 LET G=PEEK 16396+256*PEEK 1
6397
2070 LET G=G+1
2080 LET H=PEEK G
2090 IF H=118 THEN GOTO 2070
2100 IF H=0 THEN LET F=F+1
2110 IF H<>0 THEN LET F=0
2120 LPRINT CHR$ H;
2130 IF F<33 THEN GOTO 2070
2140 LPRINT
2150 LPRINT "--------------------
--------------"
2160 CLS
2170 RETURN
2200 SAVE "CODE"
2210 RUN
```

Renumbering

G J Cocks,
Great Rollright,
Oxfordshire.

SPECTRUM

HERE IS a renumbering facility for the ZX Spectrum, and it will easily fit into the 16K model. The Basic program loads the machine code above a reset RAMtop, then Saves it on to tape, verifies it, and then clears the Basic program out of the memory.

Whenever you need to renumber, just enter the command:

PRINT USR 32550 : LIST

To load the machine code from tape, just type the command:

CLEAR 32549 : LOAD "renumber"
CODE 32550, 40

The machine-code program is listed with comments to help understand how it works.

```
10 CLEAR 32549
20 FOR a = 32550 TO 32589
30 READ n : POKE a,n : a
40 DATA 17,10,00,58,83,92,111,58,84,92,103,24
   14,114,35,115,6,10,19,16,253,35,78,35,
   70,9,35,58,75,92,189,32,236,58,76,92,
   188,32,230,201
50 SAVE "renumber" CODE 32550,40
60 VERIFY "renumber" CODE 32550,40
70 NEW
```

DECIMAL CODE	MNEMONIC	COMMENTS
17,10,00	Ld DE,10	Load first line no. into DE registers
58,83,92	Ld A,(23635)	Load L.S.B. of address of start into A
111	Ld L,A	Load A into L
58,84,92	Ld A,(23636)	Load M.S.B. of address of start into A
103	Ld H,A	Load A into H
24,14	Jr,14	Jump to test for end of program
114	Ld (HL),D	Alter M.S.B. of line number
35	Inc HL	Move to L.S.B of line number
115	Ld (HL),E	Alter L.S.B of line number
6,10	Ld B,10	Create next line number
19	Inc DE	By incrementing DE
16,253	Djnz 253	Until B = 0
35	Inc HL	Move to L.S.B. of length
78	Ld C, (HL)	Load L.S.B. of length of line into C
35	Inc HL	Move to M.S.B. of length of line
70	Ld B,(HL)	Load L.S.B. of length of line into B
9	Add HL,Bc	Add length of line to HL
35	Inc HL	Move to start of next line
58,75,92	Ld A,(23627)	Load L.S.B. of address of start of variables into A
189	Cp L	Compare with L
32,236	Jnz 236	Jump back to alter line number if O.K.,continue if not
58,76,92	Ld A,(23628)	Load M.S.B. of address of start of variables into A
188	Cp H	Compare with H
32,230	Jnz 230	Jump back to alter line number if O.K.,continue if not
201	Ret	Return to Basic

Speed scroll

Munir Zaman,
Levenshulme,
Manchester.

ZX-81

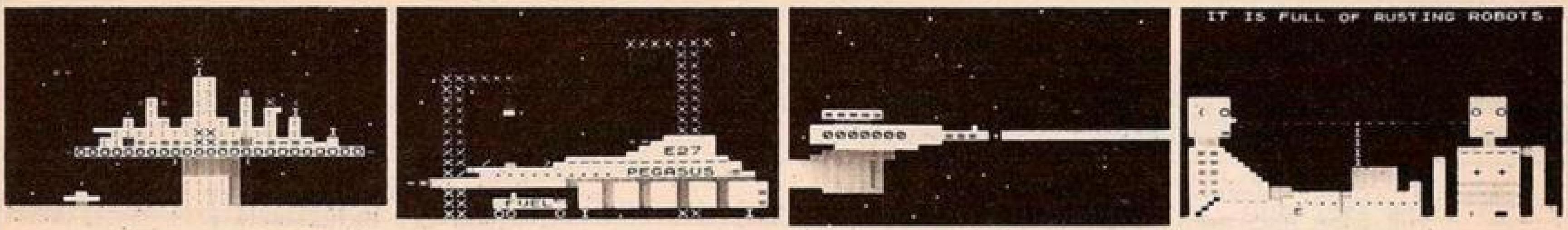
THIS PROGRAM performs the scroll function at speed without disrupting the display file. ZX-81 users will notice that clearing the screen after a scroll function takes a long time if the program is long; also printing takes a long time after a scroll function.

This program does not have these disadvantages, and it only occupies 15 bytes compared to Per Nielsen's program although it does not have the special features. The program can be stored anywhere. If in line 1 — Rem — the program can be called RAND USR 16514. Do not use the program if you have less than 3.25K of memory or if you have used SCROLL — CLS will negate this.

Z-80 assembler	hex	decimal
LD, HL, (16396)	2A, 0C, 40	42, 12, 64
PUSH HL	E5	229
LD DE, 33	11, 21, 00	17, 33, 0
ADD HL, DE	19	25
POP DE	D1	209
LD BC, 726	01, D6, 02	1, 214, 2
LD IR	ED, B0	237, 176
RET	C9	201

The following routine will load the program:

```
10 LET X = 16514 (starting address)
20 INPUT A$
30 POKE X, CODE A$*16+CODE A$ (2) -476
40 IF A$ = "C9" THEN STOP
50 LET X = X+1
60 GOTO 20
```



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A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in January. The name of the winner, the solution, and a competition report will be published in the March, 1983 issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

Competition results

THE PRIZE for the November competition was a Jupiter Ace, currently unique among micros in having Forth rather than Basic as its resident language. No less than 128 people hit upon "go Forth and multiply" to complete the sentence "The Ace would help me ...". Some people introduced a touch of variety by tagging "by Jupiter" or "by Jove" on the end. A single dissident voice rang out from P Riley with "go Forth and mystify".

But still reeling from this torrent of identical entries we made the winner R Gibson, 39 Lisburne Lane, Offerton, Stockport, Cheshire for his straightforward "go Forth and become an Ace programmer".

Other notable entries, which also managed to break away from the standard formula, were J Gearing's "injupiterbly" and "play my other cards better — especially my graphics packs" from L Unstead-Joss. In an allusion to a claim Sinclair once made for the ZX-81, G Mason suggested that the Ace would "help me run my nuclear power station".

The Catfighter's problem was perhaps too easy. It only required a simple program to provide the solution — 2,025 Wo'ny ships and 89 lenses. A mathematical approach involved noticing that the number of ships destroyed must be a square and that there is only one square between 2,000 and 2,100.

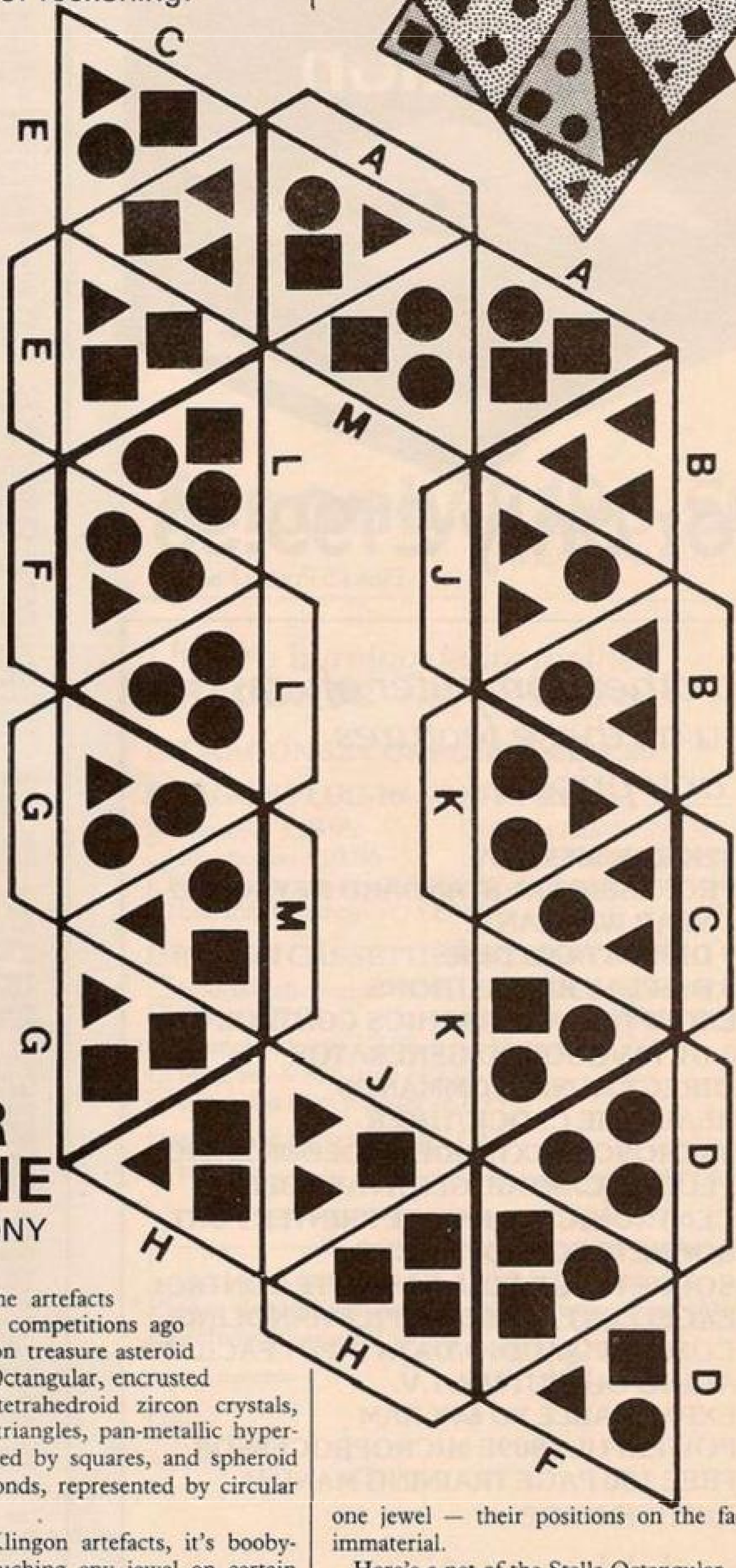
The winning solution, picked at random, was provided by P Sayer, 15 The Chase, Worlingham, Beccles, Suffolk NR34 7DW.

```
10 REM CATFIGHTER SOLUTION
15 REM BY PETE SAYER
20 C = 1999
30 C = C + 1:L = -1:W = C
40 L = L + 2:W = W - L
50 ON SGN(W) + 2 GOTO 30,60,40
60 PRINT"WONY ";C;" LENSES ";L
VARIABLES: L = LENSES
           C = INITIAL NO. OF WONY
           W = RUNNING TOTAL OF WONY
```

Solution to the November Ace crossword.







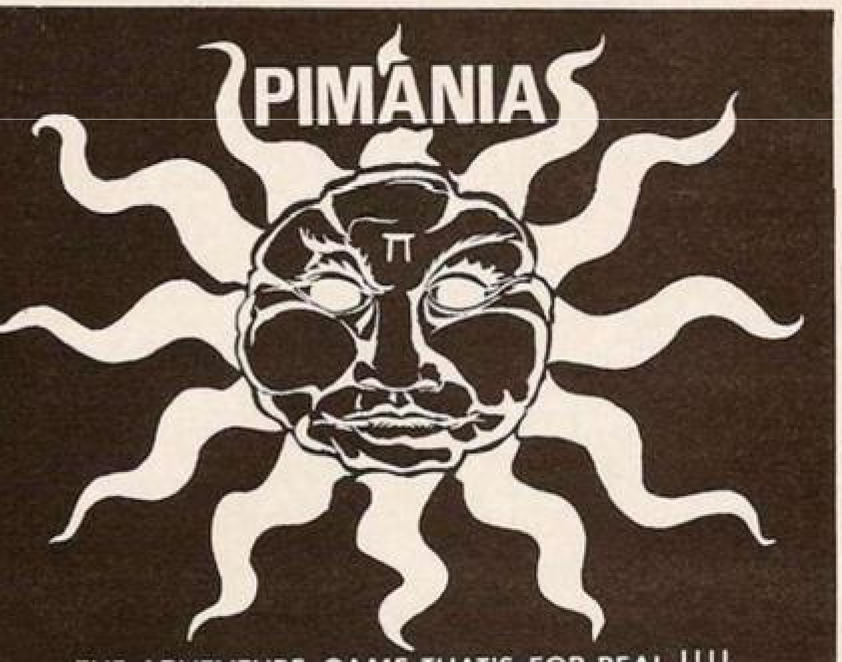
STAR STONE

BY ANTHONY ROBERTS

ANOTHER OF the artefacts you won a few competitions ago from the Klingon treasure asteroid was this Stella Octangular, encrusted with fabulous tetrahedroid zircon crystals, represented by triangles, pan-metallic hyper-cubes, represented by squares, and spheroid megacarat diamonds, represented by circular dots.

As with all Klingon artefacts, it's booby-trapped. Just touching any jewel on certain faces will cause the artefact to form a minute black hole, taking you with it, of course. The dangerous faces are the ones which are not on the longest closed loop of the adjacent faces. This loop is formed by moving from face to face, never repeating any face. Each consecutive face differs from the last by just one jewel — their positions on the face are immaterial.

Here's a net of the Stella Octangular. If you cut it out, fold the darker lines upwards, the others downwards, and stick the marked taps under the correspondingly-marked edges, you'll have a model of the artefact. You do not need to make the model to solve the problem. The question is: how many of each type of jewel are booby-trapped? ■



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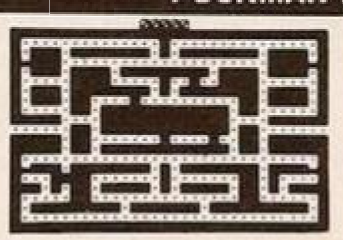
April Issue: 3D Noughts and Crosses, Moon Lander, Ellipse and 3D Surface. Plus articles on Upgrading to Model B, Making Sounds, and Operating System Calls.
May Issue: Careers, Bomber, Chords, Spiral and more.
Plus articles on Graphics, Writing Games Programs, and Using the Assembler.
June Issue: Mazetrap, Mini Word Processor, Polygon; plus articles on Upgrading, The User Port, TV set and Monitor Review, Graphics Part II, More Assembler Hints, Structuring in BBC Basic, plus BBC Bugs.
July Issue (36 pages) Invaders and patchwork programs. Fix for BBC cassette Bugs, Mode 7 explored, User define Keys, Software reviews, High res graphics printout, RS423 receive fix.
September Issue: Games programs! Higher/Lower, Hangman, plus string search program. Articles on debugging programs, a Safe Verifier, new User guide, errata, creating and moving multicolour characters, logic and the Beeb, ideas on colouring and shading, Acorn's ROM replacement charge plus much more.
October Issue. Program features: alien attack, calendar generator, Union Jack, memory display utility. Articles on debugging, improving key detection, Acorn press release on O.S.1.2. issue II Basic, the tube and second processor options, a new series for less experienced users, software reviews.

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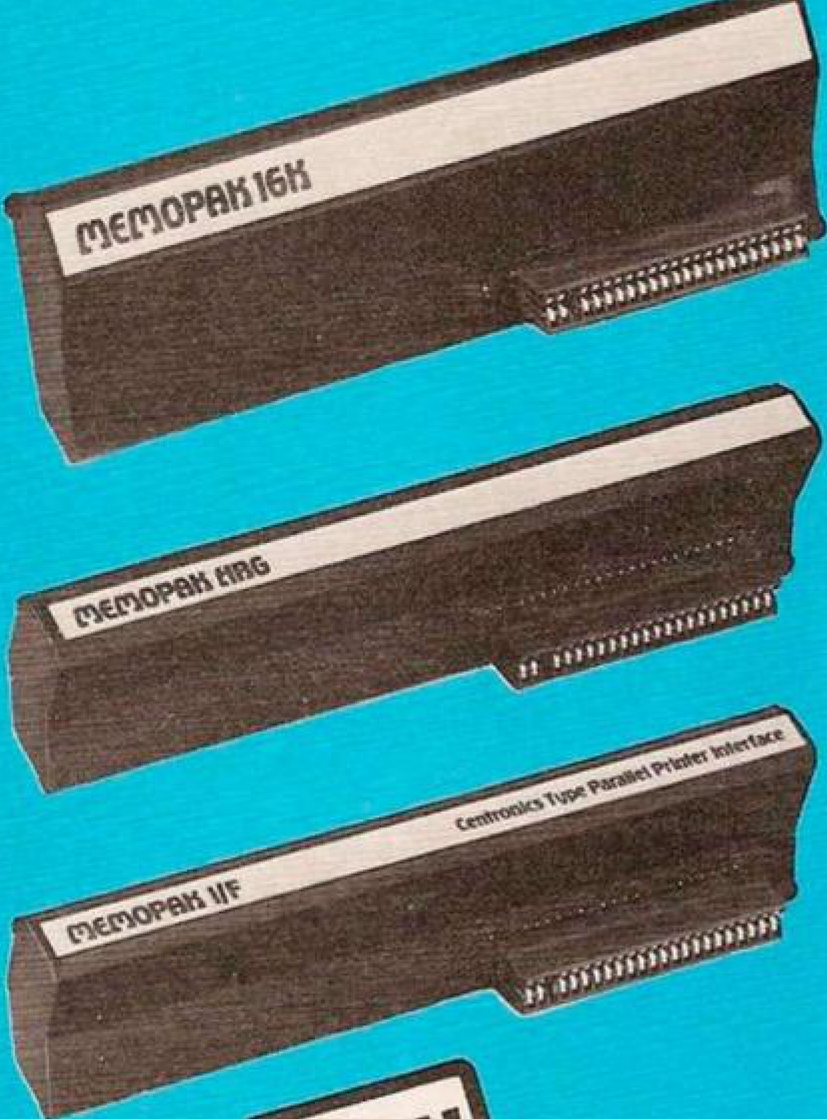
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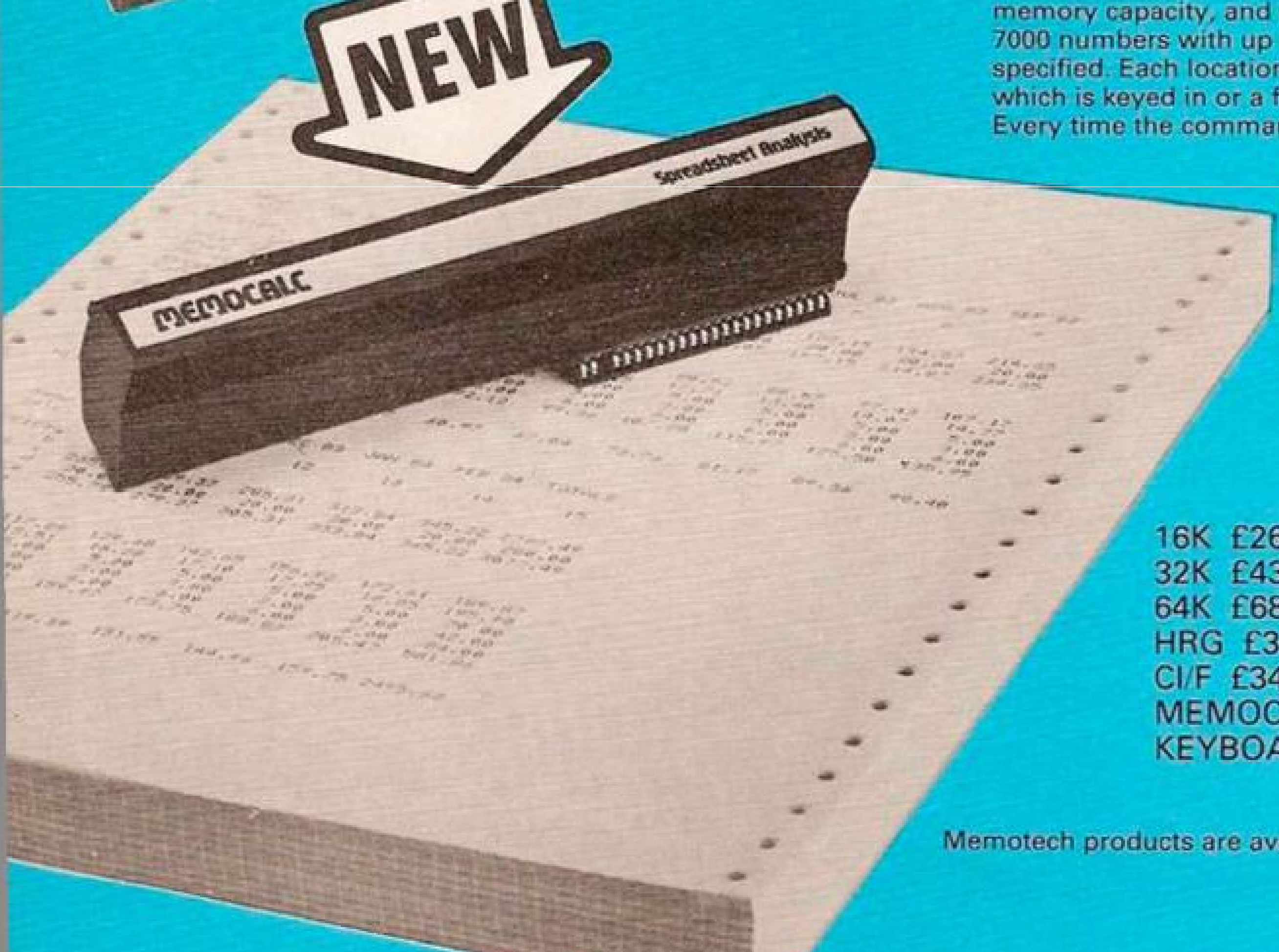


MEMOPAK 16K For those just setting out on the road to real computing, this pack transforms the ZX81 from a toy to a powerful computer. Data storage, extended programming and complex displays become feasible.
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MEMOPAK HRG This pack breaks down the constraints imposed by operating at the ZX81 character level and allows high definition displays to be generated. All 248 × 192 individual pixels can be controlled using simple commands, and the built in software enables the user to work interactively at the dot, line, character, block and page levels. Scrolling, flashing and animation are all here.

MEMOPAK Centronics I/F The BASIC commands LPRINT, LLIST and COPY are used to print on any CENTRONICS type printer. All ASCII characters are generated and translation takes place automatically within the pack. Reverse capitals give lower case. Additional facilities allow high resolution printing. The full capabilities of your printer are now under the control of the ZX81.

MEMOCALC The screen display behaves as a 'window' on a large sheet of paper on which a table of numbers is laid out. The maximum size of the table is determined by the memory capacity, and with a MEMOPAK 64K a table of up to 7000 numbers with up to 250 rows or 99 columns can be specified. Each location in the table can be either a number which is keyed in or a formula which generates a number. Every time the command to 'calculate' is given, all the formulae in the table are re-evaluated. Spreadsheet analysis started as an aid to cash-flow analysis, but this powerful tool has now been generalised and MEMOCALC with its special ability to perform iterative calculations is invaluable in the performance of numerical tasks.



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Memotech has a reputation for professional quality, producing units which are designed to fit perfectly, to look well-balanced, and to work efficiently and reliably.

The modular approach gives ZX81 owners the freedom to design the system they really need. Furthermore, the intercompatibility of the modules ensures that later additions will click straight in, to give you a system that grows with your ambitions and abilities.

To ensure that your expectations are realised, care is taken at every stage to design features into the system to anticipate your frustrations and to forestall them. For example:

A) Memories are cumulative e.g. 16K and 32K can be added to the MEMOPAK 16K or even to the Sinclair 16K RAM pack.

B) The HRG firmware allows commonly used constructions (such as scrolling, shading and labelling graphs), which might otherwise be beyond the user's programming capabilities, to be evoked by a few simple commands.

C) The Centronics I/F converts ZX81 character codes into ASCII and extends the print line to the width of the printer, still using the LLIST, LPRINT and COPY commands.

As one example, a system with 16K of memory and MEMOCALC is all that is required to perform sophisticated numerical calculations giving the same results as a computer at 10 times the price. The problem may be as complicated as a cash flow or production schedule, or as simple as household accounts or pocket money budgeting. If the bank manager wants to see the cash flow, then a single print instruction to the Centronics I/F will give a printout which is more than acceptable to any bank.

The example system which is shown below, on the other hand, would satisfy the needs of someone who wanted to enter data via a light-touch keyboard, construct and label graphs, and then copy the screen to an 80-column printer. Only 16K of memory is used here but with additional memory, more than one video page can be stored. Up to 7 successive pages can be displayed cyclicly to give animated displays.

Looking forward, Memotech will continue to back the ZX81 through 1983 with fast storage devices, pressure sensitive electronic drawing boards and more software packs including a wordprocessor, an RS232 interface and a Z80 assembler.

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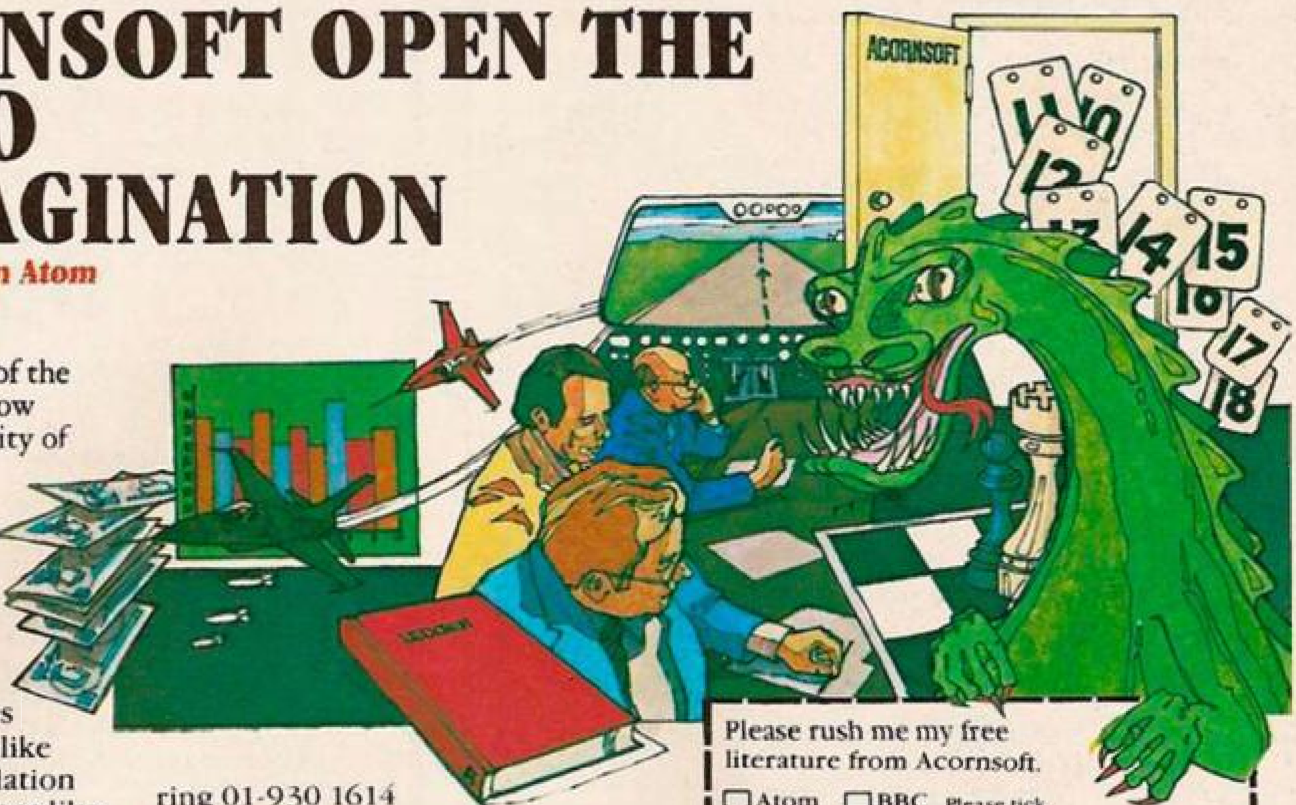


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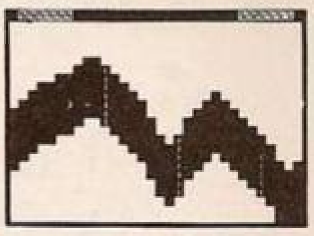
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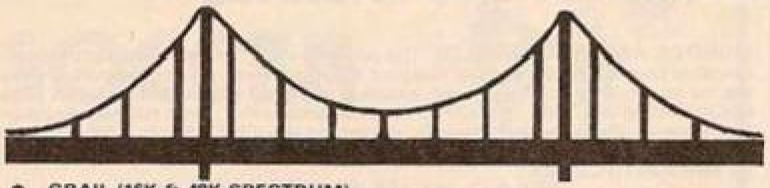
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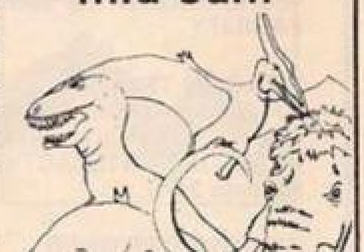
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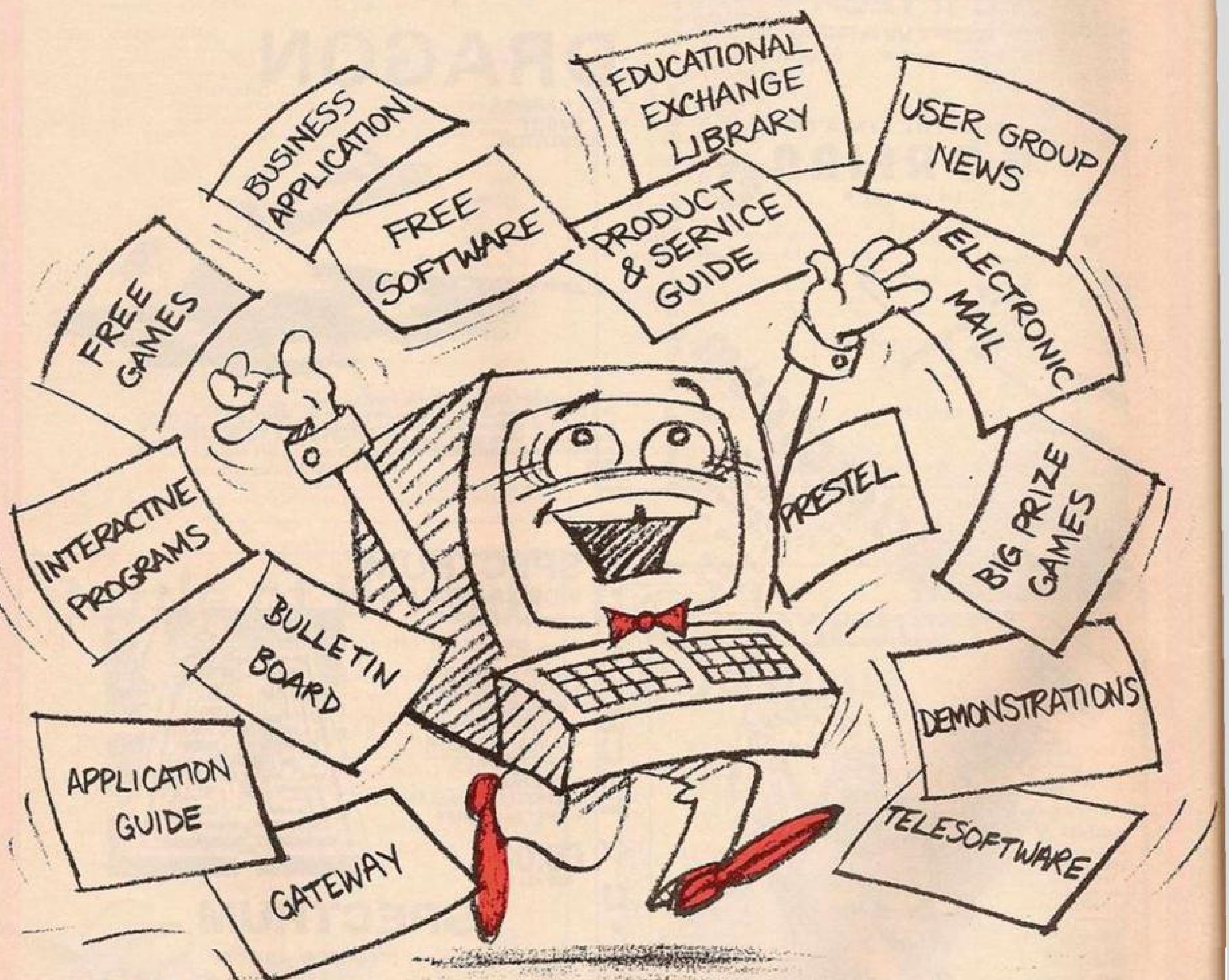


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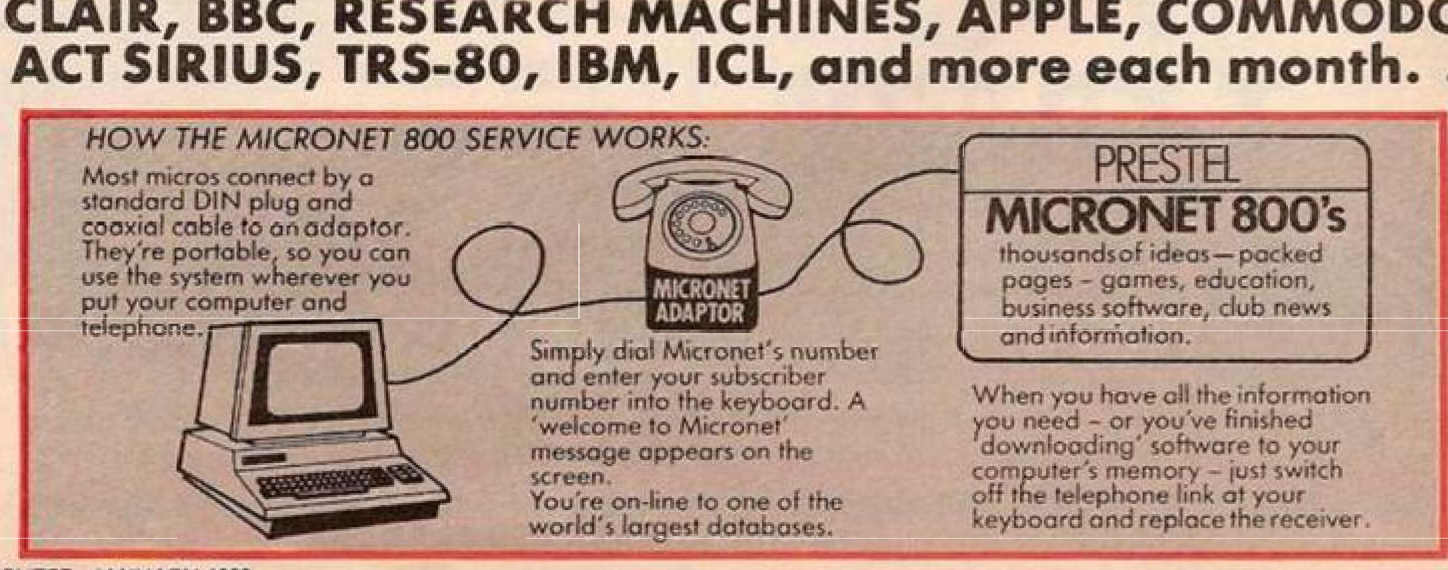


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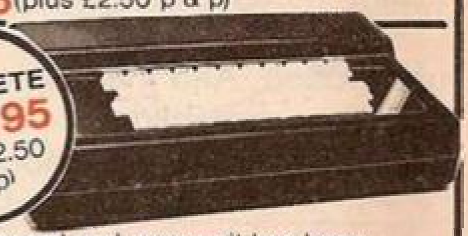
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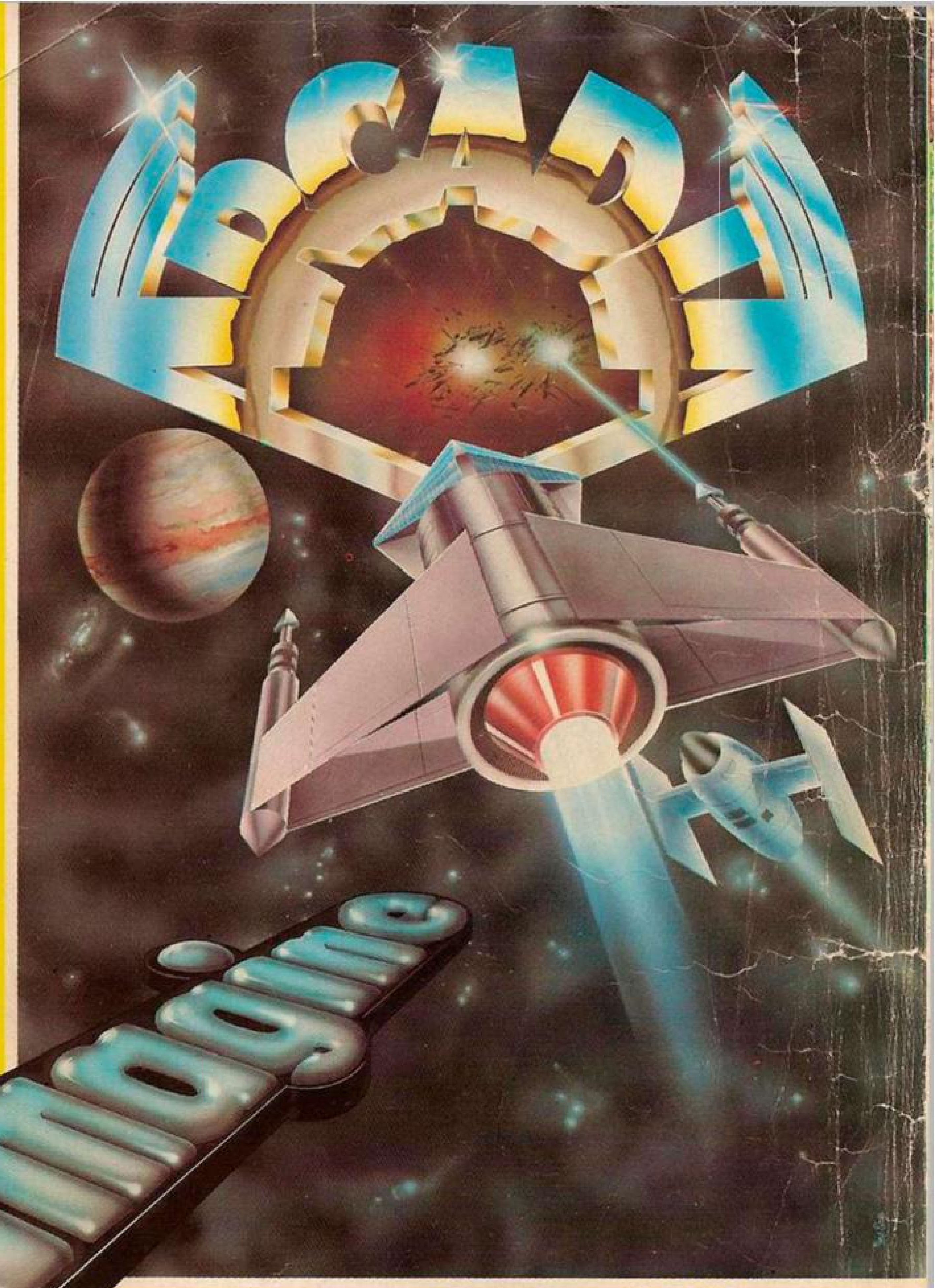
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